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Executive Development

Identification of Factors Preventing Usage of Mobile Data Terminals in the Honolulu Fire Department

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Certification Statement

I hereby certify that this paper constitutes my own product, that where the language of other is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed:_______________________________________

Abstract

The problem was Honolulu Fire Department (HFD) personnel were not using the mobile data terminals (MDTs) to change their response status while they were assigned to emergency incidents. The research purpose was to determine the reasons why HFD personnel were not using the MDTs to change their response status. Descriptive research was used to answer these research questions:

1. What problems are associated with training HFD personnel to use the MDT to change their response status while they're assigned to emergency incidents?
2. What technical problems with MDTs prohibit HFD personnel from using them to change their response status while assigned to emergency incidents?
3. What behavioral problems with HFD personnel can be identified that precludes them from changing their response status on the MDTs while assigned to emergency incidents?
4. What other issues exist that prevent HFD personnel from using the MDTs to change their response status while assigned to emergency incidents?

Officers within HFD fire operations were surveyed to answer the research questions. Statistical tests were applied to the survey data. Research results indicated (a) users need more hands-on MDT training, (b) maintaining a network connection in the mobile environment is problematic, and (c) perceived usefulness and ease of use of the MDTs have an impact on MDT user acceptance. The last result replicates the technology acceptance model (TAM), published by F. Davis in 1985.

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Introduction

HFD MDT Project Goals

From 2005-2006 the Honolulu Fire Department (HFD) deployed mobile data terminals (MDT) to all first-line apparatuses within its fire operations section. The HFD MDT project was driven by two major goals. The first major goal of the MDT project was to provide HFD fire operations personnel with real-time information to facilitate prudent decision-making at emergency incidents. The second major goal of the MDT project was to reduce response times by dispatching the HFD resource with the shortest direct route to an emergency incident (*2006-2010 Master Strategic Plan*, 2006).

In 2005, the HFD first deployed MDTs as a pilot project to first-line apparatuses in a single battalion within fire operations. Once a major hardware-software problem with the MDT was resolved from the pilot project, the MDT project manager was satisfied with system reliability. Therefore, in 2006, the HFD implemented a phased deployment of MDTs to all first-line apparatuses in the remaining four fire operations battalions. Upon completion of MDT deployment, the MDTs were installed in 42 engines, 15 aerials, 2 hazmat vehicles, 5 battalion chief vehicles, and 1 mobile command center. MDT installation into 2 heavy rescue vehicles has not been completed at the time this document was written.

The HFD MDT project is a moderately complex system that relies on a number of other systems, subsystems, and networks to function properly. The first major system in the project is the MDT itself, a ruggedized Panasonic laptop; and associated hardware installed on each HFD apparatus. The other major MDT system components are the HFD’s computer-aided dispatch system (CADS), the Honolulu City and County’s (C&C) wide area network (WAN) and geographic information system (GIS), the global positioning system (GPS), and Cingular’s

Enhanced Data rate Global system for mobile (GSM) Evolution (EDGE) digital cellular data network.

A failure or malfunction in just one of the systems, subsystems, or networks that support the MDTs will result in a malfunction or error in the MDT. MDT malfunctions or errors have negative impacts on end-user experience. Examples of negative impacts may include reduced confidence in the MDT information by system users, decreased frequency of MDT use by fire officers, and suboptimal MDT project participation among HFD personnel. These negative impacts can ultimately result in an insufficient return on investment (ROI) for the MDT project (Dehning, Dow, & Stratopoulos, 2003).

Problem Statement

The research problem is that HFD fire operations personnel are not using the MDTs to change their response status while they're assigned to emergency incidents, resulting in inaccurate time stamps captured in the CADS. Accurate CADS time stamps are essential for the HFD to improve services delivered to the public since the HFD uses CADS time stamps for response time analysis and resource allocation (*Standards of Response Coverage*, 2005).

Purpose of the Research

The research purpose is to develop and distribute a survey instrument to obtain feedback from MDT users regarding problems or difficulties with MDT use. The results and analysis of the survey instrument will support documentation of lessons learned from the MDT project. Lessons learned from the MDT project will be used to improve the end-user experience of the MDTs. Furthermore, lessons learned from the MDT project may be leveraged to maximize ROI for other information technology (IT) related projects. Finally, the lessons learned from this study can be used by other fire departments considering deployment of similar systems within their jurisdictions.

The research document will satisfy the National Fire Academy's (NFA), Executive Fire Officer Program (EFOP), Executive Development (ED) course requirements for the applied research project (ARP) (Department of Homeland Security [DHS], 2003).

Research Method and Approach

The research method used for this ARP will be descriptive. The researcher will develop and distribute an appropriate survey instrument to identify issues or problems that HFD fire operations personnel experience while using the MDTs.

Research Questions

The research will identify the reason(s) HFD personnel do not use the MDTs to change their response status while assigned to emergency incidents. Results and analysis of the survey instrument will attempt to answer the following research questions:

1. What problems are associated with training HFD personnel to use the MDT to change their response status while they're assigned to emergency incidents?
2. What technical problems with MDTs prohibit HFD personnel from using them to change their response status while assigned to emergency incidents?
3. What behavioral problems with HFD personnel can be identified that precludes them from changing their response status on the MDTs while assigned to emergency incidents?
4. What other issues exist that prevent HFD personnel from using the MDTs to change their response status while assigned to emergency incidents?

ARP required elements and sections

This ARP will contain 7 required elements, which are: (a) the Title page, (b) the Certification Statement, which assures originality of the ARP content by the researcher, (c) the Abstract, (d) the Table of Contents, (e) the Main body, (f) the Reference list, and (g) appendices. Within the ARP main body, there will be 7 sections: (a) the Introduction, which is this section, (b) Background and Significance, (c) Literature review, (d) Procedures, (e) Results, (f) Discussion, and (g) Recommendations (DHS).

Background and Significance

Purpose of this Section

In this section, the background of the problem introduced in the previous section will be explained. The past, present, and future impact of the problem on the HFD will be discussed in this section. The method in which this ARP is related to the NFA, EFOP, ED course will also be discussed. Finally, linkage between this ARP and one of five USFA operational objectives will be established (DHS).

Background of the HFD

The HFD protects the entire island of Oahu, 604 square miles that comprise the C&C of Honolulu. King Kamehameha III established the HFD in 1850. The HFD is considered the 12th largest metro fire department in the U.S. For the fiscal year 2006, the HFD operating budget was approximately $68 million. The HFD received initial accreditation from the Commission on Fire Accreditation International in 2000, and reaccredidation in 2005. The Fire Operations section of the HFD provides multi-mission emergency incident response with a workforce of approximately 1,100 career fire fighters from 44 stations in 5 battalions. Fire Operations provides fire suppression, emergency medical service (EMS), technical rescue, and hazardous materials incident response to over 900,000 residents and over 5,000,000 visitors annually. The resource numbers and types within Fire Operations are (a) 42 engine companies, (b) 13 ladder or quint companies, (c) 2 rescue companies, (c) 2 hazardous materials companies, (d) 2 tower companies, (e) 1 fireboat company, (f) 5 battalion commanders, (g) 1 assistant fire chief, (h) 5 tankers, (i) 1 mobile command center (MCC), (j) 2 helicopters, and (k) 1 helicopter tender. For 2005, HFD Fire Operations responded to approximately 35,000 emergency incidents. The HFD's Administrative Services Bureau, Support Services Division, and Planning and Development support Fire Operations (*Annual Report*, 2005).

Past, present, and future impact of the problem on the HFD

Three drivers of IT use

Fundamentally, three principles of IT drive IT diffusion throughout many societies, organizations, and even fire departments. The first principle is Moore's law, first published in 1965, which states the number transistors on an integrated circuit doubles every 12-18 months (Moore, 1965). Therefore, computers become more powerful while the price of a given level of computing power is reduced in half, every 18 months. The second principle is Metcalfe's law, which declares that the value of a network is proportional to the square of the number of nodes. Hence, as a network grows, the value of being connected to it grows exponentially, while the cost per user remains the same or even decreases (McAfee & Oliveau, 2002). The third principle is Gilder's law, which declares the total bandwidth of communication systems triples every 12 months (Alberts & Hayes, 2003). The constantly increasing performance-to-price ratio of consumer electronics such as computers, televisions, and cellular phones can be attributed to these three principles of IT.

The use of IT in the HFD

Advances in IT and telecommunications have brought numerous innovations to the fire service (Anderson, 2002), just as IT has to other industries. The use of information technology now permeates most large, modern fire departments in the United States today (Anderson). Information technology supports such functions as computer aided dispatching (CAD), electronic fire incident reporting, radio communications (*Tactical Interoperable Communications Plan*, 2006) and even firefighting equipment maintenance (Anderson).

Since 2000, the use of IT has steadily gained traction throughout the HFD. An Ethernet WAN connects 44 fire stations around the island of Oahu to the C&C of Honolulu network domain. The HFD's 300-node WAN provides file sharing, print server, e-mail, intranet, and Internet functions to the HFD's 1,200 personnel. The HFD has been gradually progressing from paper-based reporting to all-electronic reporting since initiating Y2K compliance efforts in the late 1990s. Such efforts are aligned with the C&C of Honolulu's progression towards e-government.

MDT System Description

The HFD MDT is an integrated combination of computer hardware and software systems that deliver emergency incident information to fire operations personnel in a mobile environment. The primary hardware component is Panasonic Toughbook laptop computer mounted in each first-line apparatus. The MDT has a touch screen that enables personnel to press *desktop* icons on the display to perform actions and initiate processes on the computer. This feature is necessary because using a traditional computer mouse in a mobile environment would be impractical. The principal software tool installed on MDT is *Visinet Mobile* by Tritech Software Systems (TSS). Visinet Mobile receives and displays incident dispatch information such as address, incident type, response status, and assigned incident radio tactical channel that is sent by TSS's CADS over a wireless network to the MDT. MDT systems are rapidly gaining traction among police and fire departments throughout the U.S. and other industrialized nations (Anderson, 2002).

The MDT receives a global positioning system (GPS) signal and updates the apparatus location every 5 seconds back to the CADS. The CADS tracks the location of all MDT-equipped apparatuses in a georeferenced database. Once an emergency incident location is entered into the CADS, the location is verified by the CADS streets database. The CADS then recommends a dispatch *solution* based on (a) incident location, (b) a pre-defined response plan according to incident type, and (c) the real-time location of the HFD apparatus with most direct route to the incident location. This process is known as dynamic dispatching, which is based on the updated GPS location of each HFD resource. Dynamic dispatching represents a paradigm shift from the traditional method of fire dispatching based on first-due areas. Effective use of dynamic dispatching will theoretically reduce overall incident response times for the HFD. Furthermore, dynamic dispatching will assist with efforts by fire operations to meet the fire suppression and emergency response goals described in the HFD's *Standards of Response Coverage* (2005).

Other types of information that may be viewed on the MDT include all emergency incidents within the jurisdiction, response status of other HFD resources, and messages from other Visinet Mobile units. In addition, there is a graphical mapping component that displays incident location, fire hydrant locations, building footprints, parcel outlines, water utility networks, and other geographic features on the MDT. Providing these types of information to fire operations companies while responding to emergencies enables improved situational awareness for company commanders and incident commanders (IC).

Reaching beyond low-hanging fruit

While computerized file storage, word processing, e-mail communications, and Internet browsing represent improved processes compared to similar manual processes 10-20 years ago, such computerized processes are known as *low-hanging fruit* within the IT research community. Gross, Do, & Johnson (2000) described low-hanging fruit as the most obvious and easy applications of IT for organizations to implement. Within businesses and other for-profit organizations, significant value or ROI may be obtained when these organizations leverage IT to lower their costs or differentiate their products from their competitors. To summarize, businesses ultimately use IT to maximize profitability (McAfee, 2002). For non-profit and government organizations that don't have requirements for profitability, metrics for IT ROI are comparatively more complex. For these agencies, substantial ROI from IT may be obtained when IT is leveraged to facilitate execution of strategy or provide value-added services to the public.

The HFD MDT project is an example of an organization reaching beyond the low-hanging fruit. Information such as incident location, assigned and available resources, fire hydrant locations and flow pressure, hazardous materials facilities, and pre-fire plans can be retrieved from the MDTs. HFD fire operations ICs and company officers may use information from the MDT to improve their situational awareness of an emergency incident. Situational awareness is a significant factor associated with decisions affecting firefighter safety at emergency incidents, according to research by Omodei, McLennan, & Reynolds (2005).

ARP Justification

Over the past several years, the HFD has invested substantial human and financial resources in various IT projects. This ARP may help the HFD to identify factors that need to be addressed so personnel increase productivity and efficiency while using the MDTs. This study may also help the HFD identify factors that affect end-user acceptance and utilization of the MDT and other IT systems. The study may determine the applicability of the technology acceptance model (TAM) for the HFD. The application of the TAM may help the HFD predict acceptance of new technology by firefighting personnel through two factors previously listed, perceived ease of use and perceived usefulness (Adams & Nelson, 1992). According to research by Davis, perceived usefulness is the strongest driver of IT usage (Venkatesh & Davis, 2000). Davis also discovered employees are more likely to use a technology if they believe that it is useful for their particular jobs. Due to the impact of perceived usefulness, it is crucial to identify what causes employees to consider a technology as useful. Therefore, this study may also help management develop strategies to increase user acceptance and use of IT.

While many organizations have invested significant financial resources in IT, they have not realized corresponding gains in productivity because personnel don't always use the technology effectively, according to University of Arkansas professor Fred Davis (Benamati & Rajkumar, 2002). Davis considers nominal returns from organizational investment in IT are a critical problem. He also believes understanding and creating situations to facilitate technology acceptance by employees is a high-priority issue (Benamati & Rajkumar). The HFD could improve productivity and efficiency of its personnel if the HFD leveraged more of its IT potential (Pearson, Crosby, Bahmanziari, & Conrad, 2002).

Research Problem Linkage to USFA Operational Objectives

The research problem in this ARP is linked to the USFA operational objective “to respond appropriately in a timely manner to emerging issues” (DHS, 2003, p. II-2). In recent years the HFD has made substantial investments of financial and human resources into IT related projects (*2006-2010 Master Strategic Plan*, 2006). Insight into the research problem will help the HFD to identify factors that have an impact on IT systems utilization by fire department personnel. The research problem is also linked to the USFA operational objective to reduce loss of life of firefighters (DHS). Effective MDT use by company commanders and ICs may improve situational awareness and provide a common operational picture for fire operations personnel during emergency incidents. The information provided to ICs by improved situational awareness and a common operational picture may improve the safety of fire ground operations.

Definition of Terms

Georeferenced: “To assign coordinates from a known reference system, such as latitude/longitude, universal transverse Mercator, or State Plane, to the coordinates of an image or planar map” (Kennedy, 2003, p. 57).

Literature Review

Purpose of this section

The purpose of this section was to achieve an exhaustive review of related literature associated with the research problem. The literature review was intended to support the researcher during investigation of the problem. This section concentrated on the discovery of other similar cases where organizations leveraged IT to improve situational awareness. This section also focused on the possible application of the technology acceptance model (TAM) or other similar models to the research problem. Through review of prior similar studies, a benchmark or starting point was established for this ARP.

Literature Review Methodology

The Literature Review began with examination of various reference materials at the NFA's Learning Resource Center. Research continued at various Honolulu public libraries, Hawaii Pacific University's library, and the University of Hawaii's libraries. Research for this ARP was also conducted using EBSCO's (http://web.ebscohost.com/) online research database and Google's Scholar search engine (http://scholar.google.com/). The search for reference material first started with materials that were related to mobile computing and public safety agencies. Subsequent searches included peer-reviewed journals related to management of information systems and military strategies. Finally, the HFD's own internal documents, memos, meeting minutes, manuals, and publications were examined for the Literature Review.

Organization of the section

The section begins with a discussion of the need for personnel within organizations to acquire new skills or capabilities to remain competent. The section will also discuss motivational factors organizations may deploy so personnel will readily accept new tasks or challenges. The TAM will also be examined to explain an individual's motivation to use IT. The chapter will examine effects of rapidly evolving IT advancements to personnel in organizations. Finally, the chapter will discuss trends in IT that may potentially impact the fire service.

Organizational Need for Learning

Pearson, Bahmanziari, Crosby, & Conrad (2002) believe the knowledge or skills personnel of an organization acquire during the course of employment has a significant impact on the goals and long-term objectives of the organization. Chan (2000) states managers definitely need a better understanding of IT's impact on organizational strategy and economic performance. Improved understanding of the factors that drive such performance could help an organization increase utilization of resources and maintain or enhance competitive advantage. Demand has been growing on information systems researchers to formally document the relationship between IT investment and organizational strategic and economic benefits.

Ralph Szygenda, CIO of General Motors (GM), states that companies are deploying information systems throughout their operations at only the fifth-grade level (Dehning, Dow, & Stratopoulos, 2003). Research in information systems quality has concluded that higher user involvement and utilization leads to a higher perceived success rate for IT projects. A higher success rate is characterized by greater satisfaction or higher perceived usefulness (Ma & Liu, 2004). Successful systems deployment depends to a large extent upon the amount of communication and understanding between analysts and users. When the analyst and user cooperate and share similar ideas of design problems and events, they tend to produce more successful systems (Adams & Nelson, 1992).

Many researchers believe that implementing and leveraging IT is crucial to an organization's success. Mirchadani and Motwani (2001) report IT is an integral part of an organization's growth and wise investment in IT has the potential of significant reward. They declare such investment in IT should be an integral part of the organization's strategy for maximum effect. Few managers appreciate the importance of IT; therefore it is imperative to transform the perception of IT within an organization. Agarwal, Sambamurthy, and Stair (2000) declare that personnel within an organization select what and how to integrate technology. They also claim the test of IT integration exists within rapidly evolving technological environments. They conclude IT implementation into organizations achieved maximum benefit when individual users accepted IT.

In a study by Marcolin, Compeau, Munro, and Huff (2000, March) researchers claim organizations face immense pressure to maximize benefits from their investments in IT. Such organizations are challenged not only just to use IT, but also use it effectively as possible. As organizations downsize and restructure they are compelled manage their intellectual capital and the emphasis on productivity is emphasized. Successful organizations will be those that learn to maximize advantages from IT most effectively. Ineffective organizations act quickly to adopt new technology but fail to use new technology well. In these situations the major problem is greater emphasis on individual achievement than productivity in the workplace. Recognizing methods to assess user competence is crucial to maximize effectiveness of IT use.

Agarwal and Karahanna (2000) declare that in today's increasingly global, digital, and networked economy, IT represents a considerable investment for most organizations and comprises a significant aspect of organizational effort. However, the value of IT investment is captured only when information systems are utilized by their intended users in a manner that contributes to the strategic and operational goals of the organization.

Motivational Factors

Several theoretical models have been used to study user acceptance and behavior of emerging information technologies. While many of the models include perceived ease of use as a factor of acceptance, the technology acceptance model (TAM) (Davis 1989, Venkatesh, 2000) is the most popularly applied model of user acceptance and usage. The TAM was adapted from the theory of reasoned action (TRA) (Agarwal & Karahanna, 2000). The TAM revealed that two specific beliefs, perceived ease of use and perceived usefulness determine a person's motivation to use a technology.

Certain individuals may be motivated to acquire new skills once they recognize the personal or organizational benefit (Igbaria, Hsu, Klein, & Lin, 2000). Computer applications can automate many well-defined or repetitive tasks and considerably decrease processing time. Furthermore, the reduction in repetitive work allows individuals to concentrate on more complex tasks and enhance their individual performance (Avolio, 2000).

In a 1996 study by Igbaria and Parasuraman, 471 professionals and managers in 62 companies were surveyed to test a motivational model of computer use. The study proposed perceived usefulness, perceived fun and enjoyment, and social pressure would cause increased computer utilization. The study discovered that perceived usefulness is the primary motivator for computer use. The study also found perceived complexity is a substantial negative factor that impacts computer use. In addition, the study found skills have an important role affecting computer usage. Skills directly drive computer use and influence usage by affecting perceived usefulness, perceived enjoyment, and social pressure.

In a study by Bahmanziari, Pearson, and Crosby (2003), the lack of complete information concerning a new technology can stall adoption of the technology by potential users. Due to the lack of complete information, control and vulnerability of the potential user, the adopter must trust new technology in order to commit to using it. Control relates to an individual's perception of the availability of knowledge, resources and opportunities required to perform a specific behavior. The researchers found trust is an important factor in deciding to adopt a new technology. While the researchers admitted perceived ease of use and perceived usefulness remain necessary for new technology adoption, trust in a new technology and its provider is also significant motivator for the technology adoption decision. A potential adopter must determine the trustworthiness of new technology based on characteristics of the technology and its provider.

The Technology Acceptance Model

The TAM by Davis is widely accepted throughout information systems research as a robust and legitimate model that describes ease of IT use, IT usefulness, and intention to use IT. Indeed, a search of the EBSCO online research database using *technology acceptance model* as a keyword and *peer-reviewed journals* as a parameter returned more than 400 individual citations. Davis established the TAM in 1986 based upon the TRA (Adams & Nelson, 1992). The TRA demonstrated individuals rationalize practical and social impacts of their actions when deciding what to do. Individuals then devise a plan of action based on *value-bearing* ideas concerning impact of the behavior and beliefs about others' opinion of the behavior. TRA also claims an individual's execution of a specific behavior and intent is mutually determined by that individual's attitude and *subjective norm* concerning the specific behavior (Koufaris, 2002).

The TAM has been the basis for many studies in information systems (IS) since it was first introduced. The TAM was developed to forecast and explain the voluntary usage of IT in the workplace. The primary purpose of TAM was to establish a foundation for detecting the impact of external factors on internal beliefs, attitudes, and intentions. External factors might consist of system design, training, documentation, and user support. Such external factors are expected to impact intentions and usage through perceived ease of use and perceived usefulness (Davis, 1989). The TAM recommends perceived usefulness and perceived ease of use as drivers for an individual's use of a new technology (see Figure 1). TAM variables have been verified to be reliable and legitimate in many applications and replications that included diverse technologies and user populations (Wexler, 2001). The TAM has also received extensive support through numerous studies as described in a meta-analysis by Ma and Liu (2004). In these studies the TAM has been found to be a robust model regardless of time, environment, populations, and technologies.

The TAM is also based upon the theory of planned behavior (TPB), which was used to interpret and forecast individuals' behavior in various settings (see Figure 2). The TPB was used to examine user reactions and technology usage performance of 118 workers introduced to a new software system over a five-month period. The TPB found technology usage decisions by younger workers were positively influenced by attitude toward using technology, while older workers were positively influenced by subjective norm and perceived behavioral control (Venkatesh & Morris, 2000).

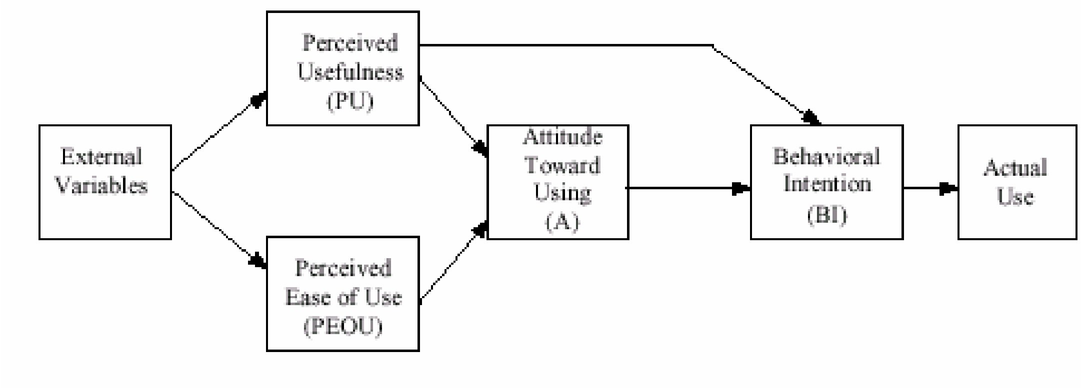

Figure 1.

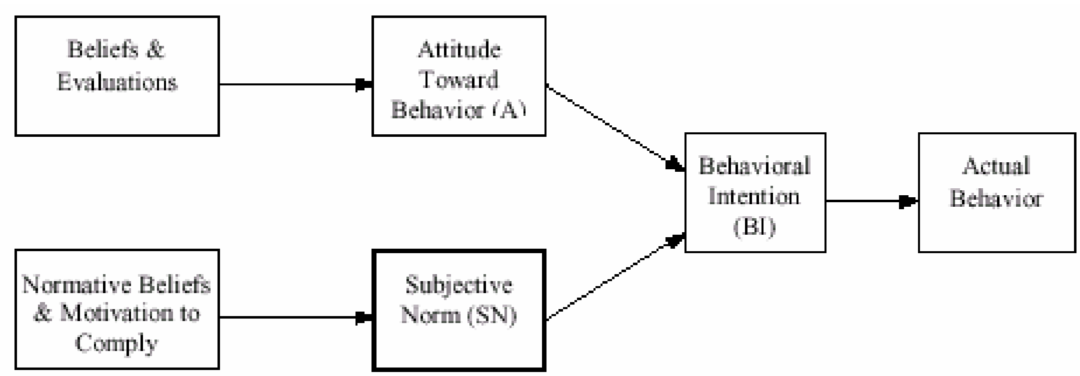

Figure 2.

TAM research has spawned additional studies on factors influencing IT utilization behavior such as the task-technology fit model (TTF) by Dishaw, Strong, and Bandy (2002) (see Figure 3). Research in this area includes the study of Perceived Computer Self-Efficacy (Compeau and Higgins 1995), which examines users beliefs regarding their ability to perform specific tasks using a software application. Computer self-efficacy (CSE) may be defined as a judgment of an individual's ability to use a computer. Compeau and Higgins (1995) developed a 10-item, factor measure of CSE, which has been incorporated into several subsequent studies (Ma & Liu, 2004).

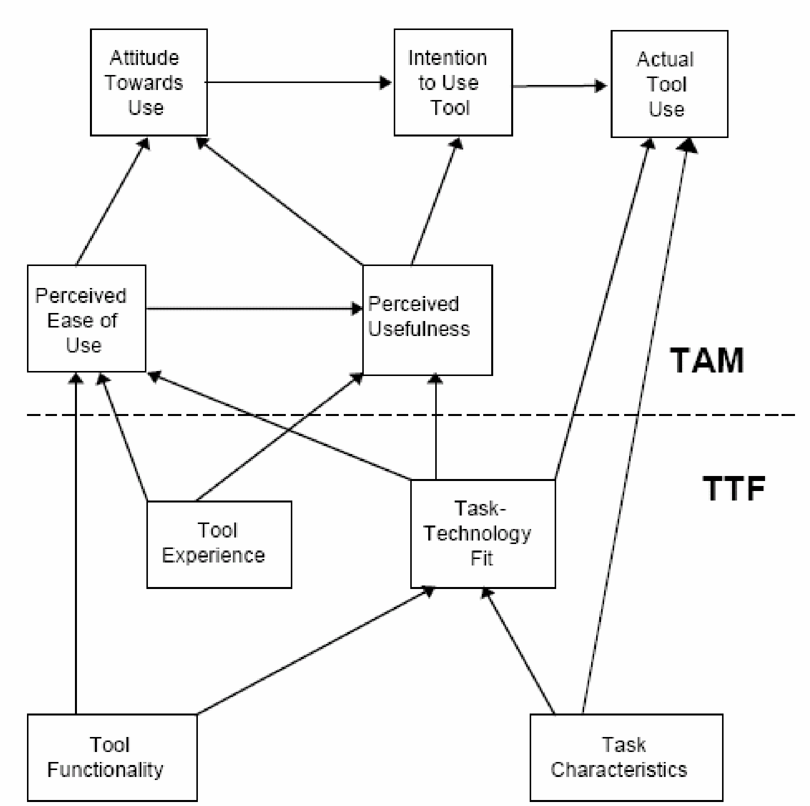

Figure 3.

Venkatesh (2000) revealed there are two primary categories of motivation: extrinsic and intrinsic. Extrinsic motivation is related with desire to perform a behavior to achieve specific goals or rewards, while intrinsic motivation relates to perceptions of pleasure and satisfaction from performing the behavior. The TAM accounts for extrinsic motivation through the perceived usefulness factor. The TAM does not explain or model intrinsic motivation, though recent research indicates it is influenced by perceived ease of use. The concept of computer playfulness has been applied in other research as a factor in intrinsic motivation. Computer playfulness is a variable related to the degree of spontaneity in computer use. The emotional aspect of IT use is associated with the concept known as computer anxiety. Computer anxiety is defined as an individual's apprehension or fear when the individual is confronted with the possibility of using IT. Computer anxiety, computer self-efficacy, and computer playfulness all relate to users' general perceptions regarding computer use. While computer self-efficacy relates to judgments about ability and computer playfulness relates to the spontaneity in an individual's interaction with a computer, computer anxiety is a negative reaction toward computer utilization.

Effect of Changes in IT on Personnel

Recent studies recognize that in addition to IT and organizations influencing each other, there is a relationship and inadvertent effect between IT and organizations that evolves over time (Avolio, 2000). Agarwal, Sambamurthy, & Stair (2000) recognized the progression of organizations is not achieved by tightly controlled processes. Organizational change is achieved through a series of adaptations that are responsive to effects from a variety of sources. The organization's leadership plays a significant role in the adaptation between the organization, IT, and external factors. If an organization intends to leverage its use of IT effectively, leadership must convey its vision of IT direction to the rest of the organization (Royer, 2003).

Federal Reserve Board Chairman Alan Greenspan testified to a Congressional Committee that IT has been the principal force in the U.S. economy in recent years, driving extensive transformations in organizational paradigms. The U.S. Commerce Department estimates that the IT industry provided at least a third of the nation's economic growth between 1995 and 1998 (Igbaria, Hsu, Klein, & Lin, 2000). Information Technology has provided gains for even the smallest organizations in domestic markets, by improved efficiencies in accounting, billing, database management, and e-commerce. For larger firms such as Wal-Mart, enterprise-wide IT systems improve efficiencies throughout the entire organization.

As more organizations depend on IT solutions for various problems, technology becomes more critical for competitive survival. Hence, the importance of the technology acceptance predicament spirals and systems that are not accepted by their targeted users will not result in projected advantages. Individuals within the organization who adopt IT early in its implementation are described by Agarwal & Venkatesh (2002) as innovators. According to the study, such individuals demonstrate a willingness to change. Within the realm of IT, such individuals are willing to experiment with any new information technology. The study further defined individuals who display these tendencies as possessing *personal innovativeness* in the domain of IT (PIIT). The innovators can function as vital change agents and leaders within the organization to facilitate adoption of new technologies by other individuals.

Trends in IT for Fire Service Organizations

During the Gulf War of 1991, Operation Enduring Freedom in Afghanistan, and Operation Iraqi Freedom, U.S. Armed Forces deployed and a system known as Network Centric Warfare (NCW). NCW integrates a combination of different information gathering devices to obtain an accurate assessment of the battlespace, available resources, and enemy positions. The assessment is known as situational awareness. Many analysts believe the capability to leverage NCW allowed U.S. forces to inflict maximum destruction upon enemy targets while practicing economy of force. In these theaters NCW facilitated target destruction while minimizing the impact of collateral damage, civilian deaths or injuries; and exposing U.S. forces to a comparatively minimal amount of casualties (Alberts, Garstka, & Stein, 2001).

NCW is based upon the need for armed forces to follow the principle of economy of force. Economy of force requires accepting prudent risk in selected areas to achieve superiority over an adversary. Economy of force involves the discriminating deployment and distribution of assets or resources for maximum effect. For instance, if a portion of an army's force is located where it is not sufficiently engaged with the enemy, or if troops are on the march while the enemy is fighting, then those forces are being managed uneconomically. Those resources are being *wasted* or not used effectively, which battlefield commanders consider worse than using them incorrectly (Murdock, 2002).

NCW integrates a variety of sensors from different platforms to accurately depict the battlespace. For example, data obtained from orbiting satellites, airborne warning and control system (AWACS) aircraft, remotely-piloted unmanned airborne vehicles (UAVs), joint surveillance and target attack radar system (J-STARS), and ground-based intelligence gathering units all combine to provide improved situational awareness for U.S. battlefield commanders. The improved situational awareness permitted the flexibility of redirecting in-flight cruise missiles in real time to new targets even after they were launched (Wall & Fulghum, 2003).

By using NCW the U.S. military hopes to reduce s*ensor-to-shooter* time, or the elapsed time from target detection to threat engagement. Sensor-to-shooter time was typically many hours or even days in past conflicts (Pustam, 2003). This lag would be highly ineffective in the current battles in Afghanistan and Iraq where mobile, flexible targets emerge within a few minutes, strike, then quickly return to hiding. The U.S. military's goal is a sensor-to-shooter time of ten minutes or less. Military planners believe the goal is achievable through the use of IT to automate many of the processes that now require human intervention (Murdock, 2002).

One of the problems U.S. military forces face is the ability to transform the multitude of data gathered into useful information (Briggs, Adkins, Mittleman, Kruse, Miller, & Nunamaker, 1998/1999). General John P. Jumper, Air Force Chief of Staff declared the ability to gather data is far greater than the ability to translate it into usable information (Briggs, et al.). General Jumper considers the ability of military personnel to use IT wisely and efficiently is a dominant factor in transforming data into information.

Conceptually, the mission of many fire service organizations has the same objectives as the military. The fire service also battles an adversary in accomplishing its mission. The adversary may be an uncontrolled fire, hazardous chemical release, building collapse, or people trapped in cars from an automobile accident. The fire service also must practice economy of force during its attack on the enemy, an emergency incident. Fire departments also continually seek to reduce their own sensor-to-shooter time, or the elapsed time between incident notification and the initial arrival of resources at the incident. Therefore, fire departments must deploy the closest available resources to an emergency. Furthermore, fire departments must also preserve the lives and property of civilians and protect fire department personnel from injury. Finally, fire departments must prevent collateral damage to property when extinguishing a fire or mitigating a chemical release.

While it is unlikely that domestic fire service organizations will deploy a network of satellites and AWACS aircraft, it is conceivable that components of technology used in NCW may trickle down larger U.S. fire departments. Global Positioning System (GPS) technology is already employed in combination with Computer-Aided-Dispatch Systems (CADS) to accurately locate fire department assets-trucks or apparatuses. The combined systems are used to dispatch the closest available and appropriate resource(s) to the emergency incident. Dispatching the closest resources to an incident helps improve patient survivability in the case of a medical response, or improve property conservation during a fire-related incident. Assigning the resource with the most direct route to an emergency is the core strategy for the HFD (*Standards of Response Coverage*, 2005).

Another example of IT in the fire service that may have originated in military is the use of MDTs. MDTs provide personnel in responding emergency vehicles to view information pertaining to an incident. Such information may consist of the address of an incident location, most direct route to an incident, occupancy type of an incident location, and known hazards for a given incident location. The information may be transmitted to responding vehicles from a remote location, or the information may be contained on any magnetic or optical drive within each MDT.

In Illinois, Buffalo Grove's fire department uses MDTs mounted in each apparatus to access detailed floor plans of every building in the community. The plans provide location of any hazardous materials, previous fire-code violations, as well as location of fire hydrants, electrical panels, gas and water shutoff valves, and other special concerns pertaining to each building. The fire department's investment in IT represented a per-capita expenditure of $9.82 (Duffy, 2000). Robert Giddens, Buffalo Grove’s CIO, explained MDT implementation for the fire department was initially difficult because the project would completely transform established processes experienced firefighters practiced on the job. Once these issues were adequately addressed to the stakeholders' satisfaction, the ROI and value created from the fire department's MDT project was much more than ten dollars per person, according to Mr. Giddens (Duffy).

Procedures

Purpose of this Section

This section will explain how the final results of the research were obtained. The procedures described in this section will provide sufficient information so others may replicate the ARP. This section will also describe methods the researcher implemented to achieve final results (DHS).

Survey Instrument

The instrument used for data collection in this study will be a two-page questionnaire listing 22 questions for the purpose of answering the research questions. The questionnaire was sent as an attachment to an e-mail message explaining the purpose of the survey to fire operations personnel. The e-mail request is displayed in Appendix A. The survey attempted to target personnel who may have the most experience with using the MDT on a daily basis. The intent is to query personnel who could provide the most accurate feedback regarding the MDTs. Therefore, the target survey sample includes battalion chiefs, fire captains, and fire equipment operators. Implementation of this method may or may not result in a totally random sample of the population, which will be described further in the Limitations paragraph of this section. Most of the questions on the survey instrument provided a Likert scale or similar measurement tool for answers. The only exception was the first question, which asked personnel to write or type their age. The questionnaire was first developed using Microsoft (MS) Excel, then the survey was copied and pasted into MS Word. The questionnaire was saved to a directory on a computer and named *MDT Survey.doc.*

Data Collection and Analysis

The questionnaire was attached to an e-mail request for survey participation sent to HFD fire operations personnel. The complete survey is detailed in Appendix B. Fire operations personnel were asked to complete the survey to the best of their ability and to return the survey by either e-mail or hard copy sent in HFD Interdepartmental mail envelopes. To preserve anonymity of personnel, the survey did not ask for identification. To further preserve anonymity, an index was created with MS Excel using the random number generator function. Surveys returned by e-mail were saved in a local directory on a computer, with each survey assigned a unique random number. Surveys returned as hard copies via interdepartmental mail were also assigned a unique random number from MS Excel. The random number was recorded on each hard copy in hand-written ink. Once all completed surveys were received and indexed, variables were coded as described in the next paragraph. The coded variables were entered into Statistical Package for Social Sciences (SPSS) 13.0 for Windows software. Once data entry was completed, statistical procedures were performed on the data. Any statistically significant result was documented in the Results section. Outputs from the statistical procedures are displayed in Appendix C.

Variables

The independent variables for this ARP are: (a) personal background, (b) length of time using the MDT, (c) MDT training, (d) perceived ease of MDT use, (e) attitudes towards MDT use, (f) intention of MDT use, (g) perceived usefulness of the MDT, and (h) problems with using the MDT. The following paragraphs lists the individual variables and detail the method for coding survey responses into the SPSS software for data analysis.

Personal background

Age, a continuous variable, was entered directly into SPSS as numerical data. Educational background, a categorical variable, uses a scale of (a) high school coded 1, (b) some college coded 2, (c) associate’s degree 3, (d) bachelor's degree coded 4, (e) post graduate work 5, and (f) master's degree coded 6. Years of experience in the HFD, a categorical variable, uses a scale of measurement with (a) less than 1 year experience coded 1, (b) 1-5 years experience coded 2, (c) 6-10 years experience coded 3, (d) 11-15 years experience coded 4, (e) 16-20 years experience coded 5, (f) 21-25 years experience coded 6, and (g) more than 26 years experience coded 7. Estimated years to retirement from the HFD, a categorical variable, uses a scale of measurement with (a) less than 1 year to retirement coded 1, (b) 1-5 years to retirement coded 2, (c) 6-10 years to retirement coded 3, (d) 11-15 years to retirement coded 4, (e) 16-20 years to retirement coded 5, (f) 21-25 years to retirement coded 6, and (g) more than 26 years to retirement coded 7. Fire department rank, a categorical variable, uses a scale of measurement with (a) firefighter recruit coded 1, (b) firefighter 1 coded 2, (c) firefighter 2 coded 3, (d) firefighter 3 coded 4, (e) captain coded 5, and (f) battalion chief coded 6.

Length of time using the MDT

The number of months using the MDT, a categorical variable, used a scale of measurement with (a) less than 1 month using the MDT coded 1, (b) 1-3 months using the MDT coded 2, (c) 4-6 months using the MDT coded 3, (d) 7-9 months using the MDT coded 4, (e) 10-12 months using the MDT coded 5, and (f) more than 12 months using the MDT coded 6.

MDT Training

Adequate training received to use the MDT, a categorical variable, used a Likert scale of strongly agree coded 1, agree coded 2, not sure coded 3, disagree coded 4, and strongly disagree coded 5. Is more training needed to use the MDT, a categorical variable, uses the same Likert scale as the preceding variable for adequate MDT training. Rank the areas of improvement for MDT training-more lecture, a categorical variable, uses a scale of most important coded 1, moderately important coded 2, slightly important coded 3, less important coded 4, not very important coded 5, least important 6, and no improvements needed 7. The other categorical variables regarding areas for improvements in MDT training: (a) hands-on practice, (b) training manual, (c) question and answer, (d) DVD, and (e) other, all use the same scale as the more-lecture variable.

Perceived ease of MDT use

Do you know how use the MDT properly, a categorical variable, uses a Likert scale of measurement with (a) strongly agree coded 1, (b) agree coded 2, (c) not sure coded 3, (d) disagree coded 4, and (e) strongly disagree coded 5. The other categorical variables regarding MDT use: (a) is the MDT easy to use, (b) is the MDT easy to understand, and (c) does using the MDT require to much effort, all use the same Likert scale as the know-how to use the MDT variable.

Attitudes towards MDT use

Does using the MDT improve safety at emergencies, a categorical variable, uses a Likert scale of measurement with (a) strongly agree coded 1, (b) agree coded 2, (c) not sure coded 3, (d) disagree coded 4, and (e) strongly disagree coded 5. The other categorical variable regarding attitudes towards MDT use: does using the MDT improve efficiency at emergencies, use the same Likert scale as the does using the MDT improve safety at emergencies variable.

Intention to use the MDT

Intent to use the MDT regularly, a categorical variable, uses a Likert scale of measurement with (a) strongly agree coded 1, (b) agree coded 2, (c) not sure coded 3, (d) disagree coded 4, and (e) strongly disagree coded 5.

Perceived usefulness of the MDT

Estimated percentage of time the MDT is working properly, a categorical variable, uses a scale of (a) never, (b) 1-25%, (c) 26-50%, (d) 51-75%, (e) 76-100%, (f) always, and (g) not sure.

Does using the MDT help you do your job, a categorical variable, uses a Likert scale of measurement with (a) strongly agree coded 1, (b) agree coded 2, (c) not sure coded 3, (d) disagree coded 4, and (e) strongly disagree coded 5.

Rank of the importance for MDT features-map layers, a categorical variable, uses a scale of (a) most important coded 1, (b) very important coded 2, (c) slightly important coded 3, (d) neutral coded 4, (e) less important coded 5, (f) least important 6, and (g) no improvements needed 7. The other categorical variables to rank the MDT features: (a) dispatch information, (b) status buttons, (c) messages, (d) unit status, (e) calls, and (f) queries, all use the same scale of measurement as the map-layer variable.

Rank the importance of MDT map layers-fire hydrant location, a categorical variable, uses a scale of (a) most important coded 1, (b) very important coded 2, (c) slightly important coded 3, (d) neutral coded 4, (e) less important coded 5, (f) least important coded 6, and (g) not important at all coded 7. The other categorical variables to rank the MDT map layers: (a) hazardous materials Tier II facility locations, (b) hospital locations, (c) school locations, (d) 40 foot elevation, (e) buildings, and (f) parcels, all use the same scale for measurement as the map-layer variable.

Rank the importance of MDT features not implemented, pre-fire plans, a categorical variable, uses a scale of (a) most important coded 1, (b) very important coded 2, (c) slightly important coded 3, (d) neutral coded 4, (e) less important coded 5, (f) least important coded 6, and (g) not important at all coded 7. The following categorical variables to rank the MDT features not implemented: (a) pre-fire plan sketch, (b) fire hydrant flow and pressure, (c) fire hydrant status, (d) fire hydrant water supply distribution network, (e) military fire hydrant locations, and (f) hazardous materials Tier II facility chemical inventory, all use the same scale for measurement as the pre-fire plan variable.

Problems with the MDT

Ranking the MDT features that cause the most problems-network connection, a categorical variable, uses a scale of (a) most significant coded 0, (b) very significant coded 1, (c) more significant coded 2, (d) moderately significant coded 3, (e) slightly significant coded 4, (f) neutral coded 5, (g) less significant 6, (h) not very significant coded 7, (i) not significant coded

8, and (j) no problems coded 9. The following categorical variables to rank the MDT features that cause problems for fire operation personnel: (a) dispatch information, (b) status buttons, (c) messages, (d) calls, (e) queries, (f) map layers, (g) apparatus battery depletion, and (h) other, all use the same scale for measurement as the network-connection variable.

Once the survey responses were loaded into the SPSS software, appropriate statistical analyses procedures were performed on the data. Output from statistical analyses will be summarized in the Results section and will be displayed in tabular form in Appendix C.

Limitations

A major limitation of this study is the survey sample is a relatively homogenous group. First, the gender of fire operations personnel in HFD is predominately male. This limitation would likely apply to a study of many small or large metropolitan fire departments in the United States. Out of the 1,000-1,100 fire operations personnel in the HFD, only six are female. Second, the ARP was limited to HFD fire operations personnel who have the most opportunity to use the MDT daily during emergency incident response. These personnel are mainly battalion chiefs, captains, and fire equipment operators (engineers). There is only one female fire captain in the HFD, and only two fire engineers, the next rank below captain, are females.

The second limitation is the majority of fire operations personnel are long-term residents of the State of Hawaii. Most HFD personnel were born and raised in Hawaii.

The third limitation of this ARP is time. The ARP was allowed a six-month timeframe for completion (DHS). The ARP is required to be sent by September 17, 2006 to the NFA, EFOP office.

The fourth limitation is the financial limitation applied to this study. The researcher is presently on a restricted budget, which will further limit the study. There may be other limitations to this study such as a partial participation rate by subjects or faulty data provided by the survey sample.

Delimitations

The scope of this study was limited to fire operations personnel in the HFD. The reason is fire operations personnel have experience in MDT use and operation. In addition, the number of survey respondents limited the sample. The research scope was delimited by the selection of research questions designed to determine specific relationships among the chosen variables.

Strengths and Weaknesses

Strengths

Test subjects may complete the survey anonymously to preserve their identities. The researcher complied with established scientific methodologies for the ARP. SPSS 13.0 for Windows will be used for statistical analysis on the data. SPSS is a powerful and robust tool that has been widely used for statistical analyses throughout many businesses and research organizations.

Weaknesses

Although the data gathered by the study will reflect responses by HFD fire operations personnel, there will be no method to validate the truthfulness of those responses. The ARP will be limited to fire operations personnel within the HFD, a relatively homogenous sample. The sample population for this ARP may not be sufficiently large to reflect a standard normal distribution. The sample population is predominantly male, as described in the *Limitations* paragraph of this section.

Assumptions of the ARP

The ARP was conducted under the following assumptions. First, the survey assumed personnel in the sample are fire fighters employed by the Honolulu Fire Department. Second, the survey assumed personnel in the sample have received training on the operation and use of the MDT. Third, the survey assumed personnel in the sample have experience in day-to-day use of the MDT. Finally, the survey personnel in the sample would furnish accurate and honest responses.

Alternatives to this ARP

The HFD may choose to hire an individual consultant or firm to identify factors that prevent MDT use among fire operations personnel. The second alternative is the HFD may use analysts employed within the Honolulu C&C to identify factors that prevent MDT use among fire operations personnel. The third alternative is the HFD may use university students seeking research problems to satisfy graduate requirements to conduct research similar to this ARP.

Definitions

Tier II. A category of chemicals required by the U.S. Environmental Protection Agency's (EPA) Emergency Planning and Community Right to Know Act (EPCRA) to be reported annually via an emergency and hazardous chemical inventory form to the Local Emergency Planning Committee (LEPC), the State Emergency Planning Committee (SERC), and the local fire department (EPA, 2006).

Results

Purpose of the section

This section will describe the study results. This section will explain if data from the survey results provides specific answers to each research question. Descriptive results for each variable will be described in narrative form in each paragraph, with the frequencies of the largest groups listed first and the frequencies of the smallest groups listed last. Although correlative procedures are not normally provided in a descriptive research project, the EFOP ARP Guidelines permit publishing unexpected results that have potential impact on the problem (DHS). Correlative results at the .05 or .01 significance level will be summarized in this section under the last research question, as these confidence levels are commonly accepted in the research community as statistically significant (APA, 2001).

Answers to Research Questions

What issues are associated with training HFD personnel to use the MDT to change their response status while they're assigned to emergency incidents?

The most significant issue regarding MDT training for fire operations personnel was the hands-on practice category. Frequency results indicated fire operations personnel ranked improvements to the MDT training hands-on practice as most important or moderately important, with a combined frequency of 51 or 61.5% of the total responses. Fire operations personnel ranked improvements to the MDT training lecture as not needed or not very important, with a combined frequency of 55 or 66.3% of the total. Personnel in fire operations ranked improvements to the MDT training manual as moderately important or most important, with a combined frequency of 31 or 37.4% of the total. Fire operations personnel ranked improvements to the MDT training question and answer session as not needed, with a frequency of 35 or 42.2% of the total. Fire operations personnel also ranked improvements to the MDT training DVD as not needed, with a frequency of 39 or 47.0% of the total. Finally, fire operations personnel rated other improvements to the MDT training as not needed, with a frequency of 78 or 94.0% of the total.

What technical problems with the MDTs prohibit HFD personnel from using them to change their response status while assigned to emergency incidents?

The frequency result that indicated the MDT is working properly 76-100% of the time was 40 or 48.2% of the sample. The group that reported the MDT is working properly 51-75% of time had a frequency 20, or 24.1% of the total. Fire operations personnel ranked problems with the MDT network connection as most significant, with a frequency of 43 or 51.8% of the total responses. The ranking of problems with apparatus battery depletion due to the MDT as most significant had a frequency of 20, or 24.1% of the total. Personnel in fire operations reporting no problems with the MDT status buttons had a frequency of 37, or 44.6% of the total. Two fire operations personnel reported other significant problems with the MDT. They reported that pressing the status button upon incident arrival distracts company officers or incident commanders from performing an incident size-up. The other MDT problem categories indicated they were not significant at a rate of 50% or more.

What behavioral problems with HFD personnel can be identified that precludes them from changing their response status on the MDTs while assigned to emergency incidents? Most fire operations personnel either agreed or strongly agreed that they intend to use the MDT regularly as required, with a combined frequency of 81 or 97.6% of the total responses. A majority of fire operations personnel agreed that the MDT is easy to understand, with 65 or 78.3% of the total responses. Most fire operations personnel also agreed or strongly agreed that using the MDT helped them do their job, with a combined frequency of 71 or 85.6% of the total. Fire operations personnel that agreed that using the MDT improves efficiency at emergencies had a frequency 39 or 47.0% of the total. A majority of personnel agreed they know how to use the MDT properly, with a frequency of 61 or 73.5% of the total. Most personnel agreed the MDT is easy to use, with a frequency of 53 or 63.9% of the total. Personnel that disagreed that using the MDT requires too much effort had a frequency of 47 or 56.6% of the total. Finally, fire operations personnel who weren't sure that using the MDT improves safety at emergencies had a frequency of 40, or 48.2% of the total responses.

What other issues exist that obstruct HFD personnel from using the MDTs to change their response status while assigned to emergency incidents?

Statistically significant correlations were found between many pairs of variables using Kendall's tau-b and Spearman's rho. The correlations reported here were significant at the .01% level, except where noted at the .05% level. Correlations were found between these pairs of variables: (a) receiving adequate MDT training and know-how to use the MDT properly, (b) receiving adequate MDT training and MDT ease of use (c) receiving adequate MDT training and MDT ease of understanding, (d) MDT ease of use and does the MDT help you do your job, (e) MDT ease of use and intention to use the MDT regularly, (f) receiving adequate MDT training and does the MDT help you do your job, (g) know-how to use the MDT properly and does the MDT help you do your job, (h) does the MDT help you do your job and intention to use the MDT regularly, and (i) at the 0.05% level for the variables number of months using the MDT and know how to use the MDT properly (see Appendix C for the entire list of correlation tables).

Descriptive Results

Fire operations personnel completed 94 questionnaires. The survey population was 204 personnel; therefore the survey return rate was approximately 46%. Eleven of the 94 were unusable due to inappropriate or partial responses. Eighty-three surveys were used for data analysis. For the sake of brevity, only the largest three groups for each variable will be reported in the following paragraphs (see Appendix C for the entire list of frequency tables).

Age

The ages of personnel in the sample ranged from 28-60 years old. The statistical mean for the ages of personnel in the sample was 47.89, the median was 49.00, and the mode was 52. Standard deviation for ages of the survey sample was 6.57. The histogram for the ages of the survey sample reveals a moderately normal, multi-modal distribution (see Figure 5 in Appendix C for the histogram).

Rank

The rank of personnel in the sample ranged from firefighter recruit to battalion chief. The rank of captain was the largest group to respond to the questionnaire, consisting of 58 or 69.9% of the total responses. The rank of firefighter 3 was the second largest group, consisting of 13 or 15.7% of the total. Battalion chiefs were the third largest group, consisting of 9 or 10.8% of the total.

Years of experience in the HFD

The group with 16-20 years experience in the HFD was the largest in the sample, with a frequency of 29 or 34.9% of the total. The second largest group had more than 25 years experience, with a frequency of 19 or 22.9% of the total. The third largest group had 21-25 years experience, with a frequency of 17 or 20.5% of the total.

Remaining years to retirement from the HFD

The group with 6-10 years until retirement from the HFD was the largest in the sample, consisting of 30 or 36.1% of the total responses. The second largest group had 1-5 years until retirement, consisting of 29 or 34.9% of the total. The third largest group had 11-15 years until retirement, consisting of 15 or 18.1% of the total.

Education level

Fire operations personnel with bachelor's degrees were the largest group of the survey sample, with a frequency of 38 or 45.8% of the total responses. The second largest group had associate's degrees, with a frequency of 23 or 27.7% of the total. The third largest group had some college, with a frequency of 12 or 14.5% of the total.

Number of months of MDT use

A majority of the survey sample reported they have used the MDT for only 1-3 months, with 42 or 50.6 % of the total responses. The second largest group reported they have used the MDT for 4-6 months, with 14 or 16.9 % of the total. The third largest group reported they have used the MDT for only 7-9 months, with 9 or 10.8 % of the total.

Estimated percentage of time the MDT is working properly

The group that reported the MDT is working properly 76-100 % of the time was the largest in the sample, with 40 or 48.2 % of the total responses. The second largest group reported the MDT is working properly 51-75% of time, with 20 or 24.1% of the total. The third largest group reported the MDT is working properly 26-50% of time, with 12 or 14.5% of the total.

Improvement needed for MDT training, lecture

The largest group in the sample reported no improvements are needed to the MDT training lecture, with 43 or 51.8% of the total responses. The second largest group ranked improving the MDT training lecture as not very important, with 12 or 14.5% of the total. The two third largest groups ranked improving the MDT training lecture as slightly important and less important, each with 9 or 10.8% of the total.

Improvement needed for MDT training, hands-on practice

The largest group in the sample ranked improvements to the hands-on practice for MDT training as most important, with 34 or 41.0% of the total responses. Two groups that ranked improvements are moderately important and no improvements are needed to MDT hands-on practice had 17 or 20.5% of the total responses each.

Improvement needed for MDT training, training manual

The largest group in the sample reported no improvements are needed to the MDT training manual, with 26 or 31.3% of the total responses. The second largest group ranked improving the MDT training manual as moderately important, with 16 or 19.3% of the total. The third largest group ranked improving the MDT training manual as most important, with 15 or 18.1% of the total.

Improvement needed for MDT training, question and answer

The largest group in the sample reported no improvements are needed to the question and answer aspect of MDT training, with 35 or 42.2% of the total responses. The second largest group in the sample ranked improvements as moderately important to the question and answer aspect of MDT training, with 17 or 20.5% of the total. The third largest group in the sample ranked improvements as slightly important to the question and answer aspect of MDT training, with 15 or 18.1% of the total.

Improvement needed for MDT training, DVD

The largest group in the sample reported no improvements are needed to the MDT training DVD, with 39 or 47.0% of the total responses. The second largest group ranked improvements as slightly important to the MDT training DVD, with 12 or 14.5% of the total. The third largest group ranked improvements as moderately important to the MDT training DVD, with 9 or 10.8% of the total.

Improvement needed for MDT training, other

The largest group in the sample reported no other improvements are needed to the MDT training program, with 78 or 94.0% of the total responses. The second largest group in the sample ranked improvements as moderately important to the MDT training program, with 4 or 4.8% of the total. The smallest group in the sample ranked improvements as most important to the MDT training program, with 1 or 1.2% of the total.

Know-how to use the MDT properly

Most fire operations personnel agreed they know how to use the MDT properly, with 61 or 73.5% of the total responses. The second largest group reported they weren’t sure they know how to use the MDT properly, with 13 or 15.7% of the total responses. The third largest group strongly agreed they know how to use the MDT properly, with 6 or 7.2% of the total responses.

Is the MDT easy to use

Most fire operations personnel agreed the MDT is easy to use, with 53 or 63.9% of the total responses. The second largest group wasn’t sure the MDT is easy to use, with 16 or 19.3% of the total responses. The third largest group strongly agreed the MDT is easy to use, with 4 or 4.8% of the total responses.

Is the MDT easy to understand

Most fire operations personnel agreed that the MDT is easy to understand, with 65 or 78.3% of the total responses. The second largest group wasn’t sure that the MDT is easy to understand, with 10 or 12.0% of the total responses. The third largest group disagreed that the MDT is easy to understand, with 6 or 7.2% of the total responses.

Does using the MDT require too much effort

Most fire operations personnel disagreed that using the MDT requires too much effort, with 47 or 56.6% of the total responses. The second largest group wasn't sure that using the MDT requires too much effort, with 17 or 20.5% of the total responses. The third largest group strongly disagreed that using the MDT requires too much effort, with 11 or 13.3% of the total responses.

Does using the MDT help you do your job

Most fire operations personnel agreed that using the MDT helped them do their job, with 56 or 67.5% of the total responses. The second largest group strongly agreed that using the MDT helped them do their job, with 15 or 18.1% of the total responses. The third largest group wasn't sure that using the MDT helped them do their job, with 8 or 9.6% of the total responses.

Does using the MDT improve safety at emergencies

Most fire operations personnel weren't sure that using the MDT improves safety at emergencies, with 40 or 48.2% of the total responses. The second largest group agreed that using the MDT improved safety at emergencies, with 20 or 24.1% of the total responses. The two third largest groups strongly agreed and disagreed that using the MDT improved safety at emergencies, with 11 or 13.3% of the total responses.

Does using the MDT improve efficiency at emergencies

Most fire operations personnel agreed that using the MDT improves efficiency at emergencies, with 39 or 47.0% of the total responses. The second largest group wasn't sure that using the MDT improves efficiency at emergencies, with 26 or 31.3% of the total responses. The third largest group strongly agreed that using the MDT improves efficiency at emergencies, with 11 or 13.3% of the total responses.

Do you intend to use the MDT regularly

Most fire operations personnel agreed that they intend to use the MDT regularly, with 63 or 75.9% of the total responses. The second largest group strongly agreed that they intend to use the MDT regularly, with 18 or 21.7% of the total responses. The two smallest groups disagreed and wasn't sure that they intend to use the MDT regularly, with 1 or 1.2% of the total responses each. There were no responses that strongly disagreed that they intend to use the MDT regularly.

Rank of MDT features, map layers

The largest group in the sample ranked the MDT map layers as very important, with 34 or 41.0% of the total responses. The second largest group ranked the MDT map layers as slightly important, with 16 or 19.3% of the total responses. The third largest group ranked the MDT map layers as most important, with 12 or 14.5% of the total responses.

Rank of MDT features, dispatch information

The largest group in the sample ranked the MDT dispatch information as most important, with 63 or 75.9% of the total responses. The second largest group ranked the MDT dispatch information as very important, with 13 or 15.7% of the total. The two third largest groups ranked the MDT dispatch information as slightly important and not very important, with 2 or 2.4% of the total responses each.

Rank of MDT features, status buttons

The largest group in the sample ranked the MDT status buttons as slightly important, with 28 or 33.7% of the total responses. The second largest group was neutral regarding the importance of the MDT status buttons, with 15 or 18.1% of the total. The third largest group ranked the MDT status buttons as very important, with 12 or 14.5% of the total.

Rank of MDT features, messages

The largest group in the sample ranked the MDT messages feature as not very important, with 18 or 21.7% of the total responses. One of the two second largest groups was neutral regarding the importance of the MDT messages feature, with 17 or 20.5% of the total responses. The other second largest group ranked the MDT messages feature as not important at all, also with 17 responses. The third largest group ranked the MDT messages feature as less important, with 15 or 18.1% of the total.

Rank of MDT features, unit status

The largest group in the sample ranked the MDT unit status feature as less important, with 23 or 27.7% of the total responses. The second largest group ranked the MDT unit status feature as not very important, with 21 or 25.3% of the total responses. The third largest group was neutral regarding the MDT unit status feature, with 15 or 18.1% of the total responses.

Rank of MDT features, calls

The largest group in the sample was neutral regarding importance of the MDT calls feature, with 20 or 22.1% of the total responses. The second largest group ranked the MDT calls feature as less important, with 17 or 20.5% of the total responses. The third largest group ranked the MDT calls feature as not very important, with 14 or 16.9% of the total responses.

Rank of MDT features, queries

The largest group in the sample ranked the MDT queries feature as not important at all, with 44 or 53.0% of the total responses. The second largest group ranked the MDT queries feature as not very important, with 17 or 20.5% of the total responses. One of the third largest groups ranked the MDT queries feature as less important, with 9 or 10.8% of the total responses. The other third largest group was neutral regarding the importance of the MDT queries feature, also with 9 of the total responses.

Rank of MDT map layers, hydrant location

The largest group in the sample ranked the MDT hydrant location map layer as most important, with 53 or 63.9% of the total responses. The second largest group ranked the MDT hydrant location map layer as very important, with 17 or 20.5% of the total. One of the third largest groups ranked the MDT hydrant location map layer as slightly important, with 4 or 4.8% of the total. The other third largest group ranked the MDT hydrant location map layer as not very important, also with frequency of 4.

Rank of MDT map layers, hazmat location

The largest group in the sample ranked the MDT hazmat location map layer as very important, with 21 or 25.3% of the total responses. The second largest group ranked the MDT hazmat location map layer as slightly important, with 18 or 21.7% of the total. The third largest group was neutral regarding the MDT hazmat location map layer, with 17 or 20.5% of the total.

Rank of MDT map layers, hospital location

The largest group in the sample ranked the MDT hospital location map layer as less important, with 34 or 41.0% of the total responses. The second largest group ranked the MDT hospital location map layer as not very important, with 15 or 18.1% of the total. The third largest group was neutral regarding the MDT hospital location map layer, with 14 or 16.9% of the total.

Rank of MDT map layers, school location

The largest group in the sample ranked the MDT school location map layer as less important, with 26 or 31.3% of the total responses. The second largest group ranked the MDT school location map layer as not very important, with 25 or 30.1% of the total. The third largest group was neutral regarding the MDT school location map layer, with 18 or 21.7% of the total.

Rank of MDT map layers, 40-foot elevation

The largest group in the sample ranked the MDT 40-foot elevation map layer as not important at all, with 42 or 50.6% of the total responses. The second largest group ranked the MDT 40-foot elevation map layer as not very important, with 14 or 16.9% of the total. The third largest group was neutral regarding the MDT-40 foot elevation map layer, with 13 or 15.7% of the total.

Rank of MDT map layers, building

The two largest groups in the sample ranked the MDT building map layer as very important and slightly important, with frequencies of 22 or 26.5% each. The third largest group was neutral regarding the MDT building map layer, with 12 or 14.5% of the total.

Rank of MDT map layers, parcels

The largest group in the sample ranked the MDT parcels map layer as not important at all, with a frequency of 18 or 21.7%. The second largest group in the sample ranked the MDT parcels map layer as very important, with a frequency of 17 or 20.5%. The third largest group in the sample ranked the MDT parcels map layer as not very important, with a frequency of 13 or 15.7%.

Rank of MDT problems, network connection

The largest group in the sample ranked the MDT network connection problem as most significant, with a frequency of 43 or 51.8%. The second largest group ranked the MDT network connection problem as very significant, with a frequency of 11 or 13.3%. The third largest group ranked the MDT network connection problem as more significant, with a frequency of 5 or 6.0%.

Rank of MDT problems, dispatch information

The largest group in the sample reported no problems with MDT dispatch information, with a frequency of 49 or 59.0%. The second largest group ranked MDT dispatch information problems as not significant at all, with a frequency of 10 or 12.0%. The third largest group ranked MDT dispatch information problems as not very significant, with a frequency of 8 or 9.6%.

Rank of MDT problems, status buttons

The largest group in the sample reported no problems with the MDT status buttons, with a frequency of 37 or 44.6%. The second largest group ranked MDT status button problems as more significant, with a frequency of 10 or 12.0%. The third largest group ranked MDT status button problems as very significant, with a frequency of 9 or 10.8%.

Rank of MDT problems, messages

The largest group in the sample reported no problems with the MDT messages feature, with a frequency of 39 or 47.0%. The second largest group ranked problems with the MDT messages feature as slightly significant, with a frequency of 9 or 10.8%. The third largest group ranked problems with the MDT messages feature as moderately significant, with a frequency of 8 or 9.6%.

Rank of MDT problems, unit status

The largest group in the sample reported no problems with the MDT unit status feature, with a frequency of 44 or 53.0%. The second largest group in the sample ranked problems with the MDT unit status feature as more significant, with a frequency of 7 or 8.4% of the total. The group that felt neutral regarding problems with the MDT unit status feature had the same frequency of 7.

Rank of MDT problems, calls

The largest group in the sample reported no problems with the MDT calls feature, with a frequency of 50 or 60.2%. The second largest group in the sample ranked problems with the MDT calls feature as not very significant, with a frequency of 9 or 10.8% of the total. The third largest group in the sample ranked problems with the MDT calls feature as slightly significant, with a frequency of 8 or 9.6% of the total.

Rank of MDT problems, queries

The largest group in the sample reported no problems with the MDT queries feature, with a frequency of 47 or 56.6%. The second largest group in the sample ranked problems with the MDT queries feature as very significant, with a frequency of 10 or 12.0% of the total. The third largest group in the sample ranked problems with the MDT queries feature as slightly significant, with a frequency of 7 or 8.4% of the total.

Rank of MDT problems, map layers

The largest group in the sample reported no problems with the MDT map layers feature, with a frequency of 36 or 43.4%. The second largest group in the sample ranked problems with the MDT map layers feature as very significant, with a frequency of 12 or 14.5% of the total. The three third largest groups ranked problems with the MDT map layers feature as more significant, slightly significant, and not significant, each with a frequency of 7 or 8.4% of the total.

Rank of MDT problems, apparatus battery drain

The largest group in the sample reported no problems with apparatus battery depletion from the MDT, with a frequency of 34 or 41.0%. The second largest group ranked problems with apparatus battery depletion from the MDT as most significant, with a frequency of 20 or 24.1% of the total. The third largest group ranked problems with apparatus battery depletion from the MDT as very significant, with a frequency of 13 or 15.7% of the total.

Rank of MDT problems, other

The largest group in the sample reported no other problems with the MDT, with a frequency of 79 or 95.2% of the total. The second largest group in the sample ranked other problems with the MDT as more significant, with a frequency of 2 or 2.4% of the total. The two smallest groups ranked other problems with the MDT as most significant and not significant, with a frequency of 1 or 1.2% of the total.

Discussion

Purpose of the Section

The researcher’s interpretation of the results will be provided in this section. This section is the only one in the ARP where the researcher will express his opinion. Links between the results other research and the results of this ARP will be established. The impact of the research results to the HFD will also be presented in this section.

MDT training

Survey results reflect 61.5% of fire operations personnel in the sample rank improvements to the MDT training hands-on practice as most important or moderately important. Statistically significant correlations at the .01 confidence level were found for the variables representing feedback that personnel received adequate MDT training and their know-how to use the MDT properly. Therefore, I believe if the HFD can improve MDT training hands-on practice, the skill level of MDT use by fire operations personnel will improve. Significant correlations were also found between the variables representing feedback that personnel received adequate MDT training and usefulness of the MDT. For HFD fire operations personnel, I believe the delivery of adequate training has a direct impact on the opinions for usefulness of the MDT.

Learning Curve

Survey results indicate 77% of the sample has used the MDT for 6 months or less. Therefore, most of the fire operations personnel from the sample are still early in the MDT learning curve. Statistically significant correlations were found for the variables representing the number of months spent using the MDT and know-how to use the MDT properly. Research by McAfee (2002) reveals operational performance will improve as users become accustomed to new IT systems and acquire experience in new system use. Hence, as fire operations personnel gain experience using the MDT, their MDT skill level will improve. As the MDT skill level for fire operations personnel improves over time, they will increase their consistency in using the MDTs to change their emergency incident response status. Consequently, the HFD may realize increased accuracy in MDT time stamps captured by the CADS. Furthermore, statistically significant correlations were found between the variables representing know-how to use the MDT properly and usefulness of the MDT. Therefore, it can be concluded that the learning curve has an indirect impact on user acceptance of the MDT. Abundant peer-reviewed research exists on the link between IT user acceptance and IT system utilization, including articles by Adams and Nelson (1992), Davis (1989), Goodhue and Thompson (1995), and Dishaw, Strong, & Bandy (2002). These studies indicate MDT acceptance and use by fire operations personnel will increase as time passes.

Behavioral Issues Related to MDT Use

Perceived Ease of Use. Statistically significant correlations were discovered between the variables representing MDT ease of use and the usefulness of the MDT. Similar significant correlations were also found between the variables representing MDT ease of use and the intention to use the MDT regularly. Therefore, the conclusion is ease of MDT use directly impacts MDT user acceptance and intention to use the MDT. One may also conclude the HFD will realize gains in MDT user acceptance and intention to use the MDT regularly if MDT ease of use is improved. These conclusions reflect research by Davis (1989), Agarwal & Venkatesh (2002), and Benamati & Rajkumar (2002). Studies by these groups found direct relationships between the characteristics: (a) IT ease of use, (b) IT user acceptance, and (C) intention to use IT.

In 2000 Venkatesh reported the Internal Revenue Service (IRS) invested approximately four billion dollars on a system intended to simplify the processing of tax returns for 1996 by computerizing the process. However, studies in early 1997 indicated that the IRS was forced to revert to the manual method of processing returns. In the IRS case and others, users have found new technologies too difficult to use and were unable to overcome such barriers preventing satisfactory user acceptance and usage of the new system (Venkatesh). Hence, understanding relationships between user acceptance, adoption, and utilization of IT systems should be high priority for any organization considering new system deployment.

Perceived Usefulness of the MDT

Most fire operations personnel agreed or strongly agreed that using the MDT helped them do their job, with 71 or 85.6% of the total responses. Statistically significant correlations were found between the variables representing usefulness of the MDT on the job and intention to use the MDT regularly. Thus, survey results indicate a relationship between MDT usefulness and intention to use the MDT by fire operations personnel. Due to the relationship between these two variables, it is no surprise the combined frequency that personnel agreed or strongly agreed they intend to use the MDT regularly was 97.6%.

Adams and Nelson (1992) believe users and systems analysts produce higher quality solutions to design problems when the users take an active position in leading and assuming responsibility than when the analyst assumes a dominant role in system design. Successful communication between analyst and user may depend on the level of computer skills a user has acquired.

MDT Technical Problems

Almost 50% of the fire operations personnel in the survey sample indicate the MDT is working properly 76-100% time, while another 24% state the MDT is working properly 51-75% of the time. I consider these results indicate very good system reliability, considering the system complexity. However, due to the MDT system's complexity, the exact reason for MDT malfunctions or errors are difficult to define and beyond the scope of this ARP.

Network connection

Most fire operations personnel rank problems with the MDT network connection as most significant or very significant, with combined a frequency of 56 or 65.1% of the total. While the MDT is within the reception area of a wireless broadband hotspot, connection to the network is very reliable. As soon as an MDT-equipped apparatus moves away from the hotspot, connection to the network is dependent upon signal reception from Cingular's EDGE technology. In this environment, MDT connection to the network becomes problematic. In the mobile environment, network bandwidth for any portable computer becomes a function of signal strength from the EDGE cellular antenna. Signal strength degrades as the signal propagates further from the cellular antenna site (Tritech Software Systems, 2003). This characteristic presents a unique dilemma for MDT project managers. MDT project goals are to provide dispatch information and improved situational awareness to fire operations in a mobile environment; yet there are significant challenges to maintain a constant MDT network connection while a fire apparatus traverses cellular coverage areas. There are many areas throughout Honolulu that lack signal coverage from the EDGE network (see Figure 4). Lack of signal coverage in certain areas may be due to the mountainous topography of Oahu. It would be impractical and financially unfeasible for any telecommunications firm to erect cellular antenna towers to provide total coverage for Oahu. Most populated areas of Honolulu have adequate signal reception from the EDGE network.

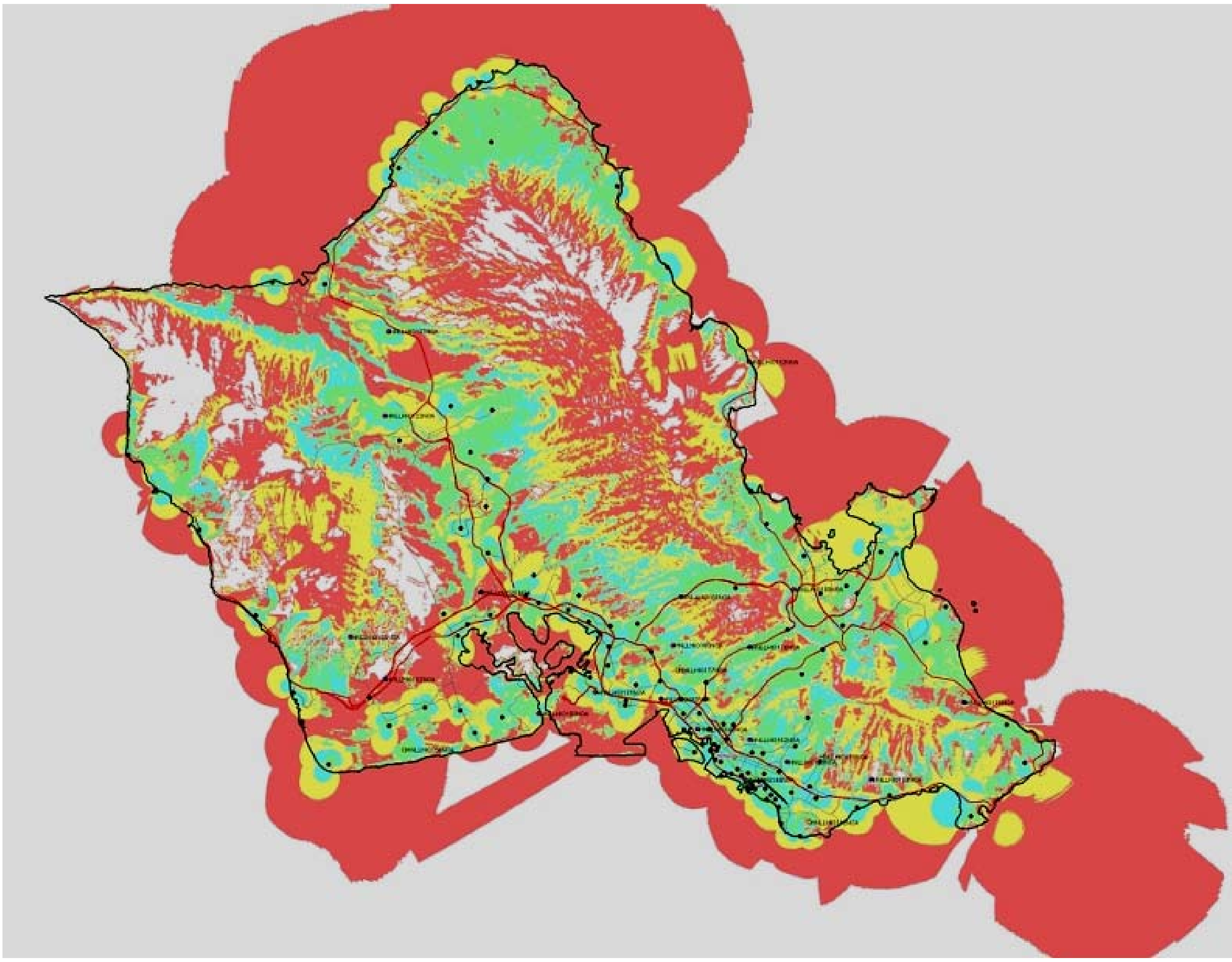

Figure 4.

Apparatus battery depletion

According to fire operations personnel, the other major technical problem associated with the MDT is apparatus battery depletion. Fire operations personnel that rank this problem as either most significant or very significant had a combined frequency of 33, or 39.8% of the total. This problem occurs while the apparatus engine is not operating and the MDT continues to run. Apparently, many existing battery charger systems can't supply sufficient current the apparatus electrical system since the addition of the MDT. Allowing the MDT to draw electrical power to such a level where the battery can't start the apparatus is counterproductive to the

HFD's mission. The potential solution to this problem is installation of onboard battery chargers to supply additional current to the apparatus. This solution is being evaluated and recommendations will follow test completion.

Status buttons

Almost 50% of fire operations personnel reported no problems or insignificant problems with the MDT status buttons. I don't believe problems with this MDT feature are preventing fire operations personnel from using the MDT to update their emergency response status.

Other MDT problems

The other categories for MDT technical problems such as dispatch information, messages, unit status, calls, queries, and map layers were ranked not significant by a majority of fire operations personnel. These MDT features are not having significant impacts on MDT usage by fire operations personnel.

Recommendations

Purpose of the Section

This section will provide recommendations to resolve the research problem. The recommendations will be based on the research results. In addition, the need for additional research will be examined.

TAM

The results for this ARP are consistent with other TAM-based research. The perception of personnel regarding the adequacy of MDT training appears to have a direct impact on their knowledge to use the MDT properly and their perceived ease of MDT use. The perceived ease of MDT use subsequently had an impact on the intent of fire operations personnel to use the MDT regularly. Training to use the MDT also appears to have an impact on perceived usefulness of the MDT system. Perceived usefulness of the MDT system is also impacted by the inherent trust of MDT in the system, which is affected by system reliability. Again, these effects reinforce TAM research results by Davis and many others (Ma & Liu, 2004). Hence, it is recommended the HFD implement improvements to MDT training as indicated by the results of this survey.

Additional Research Needed

Although results from the statistical procedures may appear to be obvious conclusions by some readers of this ARP, until empirical research methods are applied to the research problem, motivating factors and effects for IT adoption and use will be unclear. Therefore, it is recommended the HFD conduct a similar study at some time in the future to investigate the effect of the learning curve or other factors has on the research problem of this ARP. The HFD may desire to make participation by personnel in the study mandatory, in order to reach a larger sample of the population and increase research accuracy. The HFD may choose to conduct *null hypothesis significance testing* to further examine the effect perceived ease of use and perceived usefulness have on IT usage. Eventually, fire operations personnel may realize diminishing problems with MDT use as they gain experience in using the MDTs. The research results support this concept since there's a direct correlation between the length of time using the MDT and confidence of personnel to use the MDT properly.

MDT Network Connection Problem

Project managers and stakeholders are currently addressing the most significant MDT technical problems that were identified by this ARP. MDT signal reception in the mobile environment is being addressed by considering several different data network vendors who provide enhanced coverage areas in comparison to the existing Cingular EDGE network. These new solutions offer an added benefit of increased network bandwidth. It is recommended that the search for alternatives continue. The cellular voice and data industry is very competitive and there appears to be steady stream of new innovations among different vendors. In addition, industry vendors are always willing to collaborate to help solve the customers' problems. The motivating factor by the vendors is to enter into a lucrative long-term contract with potential customers.

MDT Battery Charging Problem

The second most significant MDT technical problem, depletion of the apparatus batteries is also being addressed. Some fire operations personnel have applied their own solution, such as connecting the MDT external power source to the fire station electrical outlets via extension cords. Such approaches are short-term solutions and the problem needs a long-term resolution. The root cause of this problem is fire apparatus charging systems are inadequate to supply enough current to meet the demands of additional electrical equipment. The vehicle charging systems installed in many fire stations are also inadequate because these stations were built prior to 1980. The solution may involve upgrading the electrical infrastructure of the fire station or apparatus, which is complex and potentially expensive. Alternative solutions are being explored in consultation with the HFD's apparatus mechanics and Honolulu county electricians.

Impact of MDT Improvements on System Use

According to the research results from this ARP and many other studies, any improvement to MDT system reliability will have a positive impact on the motivation of fire operations to use the MDT. Furthermore, inherent trust of the MDT system by users will increase, which has an effect on perceived usefulness of the MDT. Consequently, as the perceived usefulness of the MDT is enhanced, so will the motivation by personnel to use the MDT.

Adaptive Challenges

This ARP did not attempt to explore the impact of change and the acceptance or resistance to change from personnel within the organization. I suspect this factor may have a major effect on the attitudes and perceptions of HFD personnel related to the MDT program. Heifetz and Linsky (2002) consider problems with the MDT network connection or training program as technical problems. While technical problems are potentially resolvable with relative ease, resistance to change from HFD personnel is a significant issue. Resistance to change is defined as an adaptive challenge by Heifetz and Linsky. Technical problems may be solved with the correct application of techniques or procedures. Addressing adaptive challenges require new approaches or discoveries by individuals within the organization to effect changes in their in the views, opinions, and behaviors regarding their new environment.

Lifting the Fog of War

Warfare on the battlefield is likely the most difficult decision-making environment imaginable. The major influence is the fog of war, first described by Carl von Clausewitz in 1812. Von Clausewitz characterized the concept as “the realm of uncertainty; three quarters of the factors on which action is wrapped in a fog of greater or lesser uncertainty” (Owens, 2000, p. 12). According to Admiral Bill Owens (2000), NCW lifted the fog of war during Operation Desert Storm, providing the U.S. coalition forces with enhanced situational awareness, a common operational picture, and economy of force. I believe the fire ground is potentially the second most difficult decision-making environment. HFD fire operations will experience NCW-like benefits on the fire ground once the MDT system is optimized and HFD personnel are accustomed to using the system. Once all HFD personnel perceive the MDT as easy to use and useful, their trust in the information displayed by the MDT will increase. Consequently, fire ground operational efficiency and safety may rise due to the enhanced situational awareness and common operational picture facilitated by the MDT.

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Appendix A

E-mail Request for Survey Participation

Message for operations companies:
My name is Gary Lum, I'm a Captain presently assigned to Planning and Development.
I'm conducting a research project for the National Fire Academy Executive Fire Officer Program.
I would like to obtain your feedback on the effectiveness of the HFD's MDT program.
I'm particularly interested in the opinions of personnel that use the MDTs the most, mainly BCs, Captains, & FF3s.
Other personnel may participate if they have used the MDT or attended the MDT Training.
Participation is strictly voluntary.
Attached is a survey, please answer the questions to the best of your abilities.
Only one survey per person, please.

There are 2 ways to return the survey to me:
1. Print a hard copy, answer the questions, & return to me via Interdepartmental Mail.
2. Save a copy to your computer, answer the questions, save, & return to me as an attachment to: glum@honolulu.gov

Information obtained by the survey may also be used to improve & enhance the MDT program, or other Information Technology-related programs.

Thank You for your Support,
Gary Lum

Appendix B

MDT Survey Instrument

Enter your age in the next cell->	

Highest education level attained

High School	Some College	Associate Degree	Bachelor's Degree	Post Graduate	Master's Degree	For each statement, mark with an "X" in the appropriate box

Number of years experience in the HFD

<1	1-5	6-10	11-15	16-20	21-25	>26

Estimated years to retirement from the HFD

<1	1-5	6-10	11-15	16-20	21-25	>26

Rank

FFR	FF1	FF2	FF3	Captain	BC

Number of months you have used the MDT

less than 1	1-3	4-6	7-9	10-12	more than 12

Estimate the percentage of time your MDT is working properly

Never	1-25%	25-50%	51-75%	76-100%	Always	Not Sure

You received adequate training to use the MDT

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

You need more training to use the MDT

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

Rank the areas of improvements for MDT training (1-most, 6-least, 0-none)

More Lecture	Hands-on Practice	Training Manual	Question & Answer	DVD	Other (write in here)

Overall, you know how to use the MDT properly

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

The MDT is easy to use

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

The information on the MDT is easy to understand

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

Using the MDT requires too much effort

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

Using the MDT helps you do your job

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

Using the MDT improves safety at emergencies

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

Using the MDT improves efficiency at emergencies

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

Assuming the MDT is working properly, you use the MDT regularly as required

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree

Rank these MDT features in order of importance (1-most, 7-least)

Map Layers	Dispatch Info	Status Buttons	Messages	Unit Status	Calls	Queries

Rank these MDT Map Layers in order of importance (1-most, 7-least)

Hydrant Location	HazMat Location	Hospital	School	40FT Elev	Buildings	Parcels

Rank the MDT features that cause the most problems for you (1-most, 10-least, 0 if no problem)

Network Connection	Dispatch Info	Status Buttons	Messages	Unit Status	Calls	Queries	Map Layers	Apparatus Battery Drain

Rank these MDT features (not yet implemented) in order of importance (1-most, 7-least)

Preplans (form 9)	Preplans (drawing)	Hydrant flow & pressure	Hydrant Status	Hydrant Distribution Network	Military Hydrants	HazMat Tier II info (Chemical Inventory)

Appendix C

Table C1

Dispersion of Ages for the Sample

N	Valid	83
	Missing	0
Mean		47.89
Median		49.00
Mode		52
Std. Deviation		6.570
Skewness		-.574
Std. Error of Skewness		.264
Kurtosis		.016
Std. Error of Kurtosis		.523

Table C2

Distribution of Ages for the Sample

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	28	1	1.2	1.2	1.2
	32	1	1.2	1.2	2.4
	36	2	2.4	2.4	4.8
	37	2	2.4	2.4	7.2
	38	2	2.4	2.4	9.6
	39	2	2.4	2.4	12.0
	40	3	3.6	3.6	15.7
	41	3	3.6	3.6	19.3
	42	2	2.4	2.4	21.7
	43	3	3.6	3.6	25.3
	44	2	2.4	2.4	27.7
	45	3	3.6	3.6	31.3
	46	5	6.0	6.0	37.3
	47	6	7.2	7.2	44.6
	48	2	2.4	2.4	47.0
	49	4	4.8	4.8	51.8
	50	5	6.0	6.0	57.8
	51	8	9.6	9.6	67.5
	52	10	12.0	12.0	79.5
	53	1	1.2	1.2	80.7
	54	2	2.4	2.4	83.1
	55	3	3.6	3.6	86.7
	56	3	3.6	3.6	90.4
	57	6	7.2	7.2	97.6
	58	1	1.2	1.2	98.8
	60	1	1.2	1.2	100.0
	Total	83	100.0	100.0	

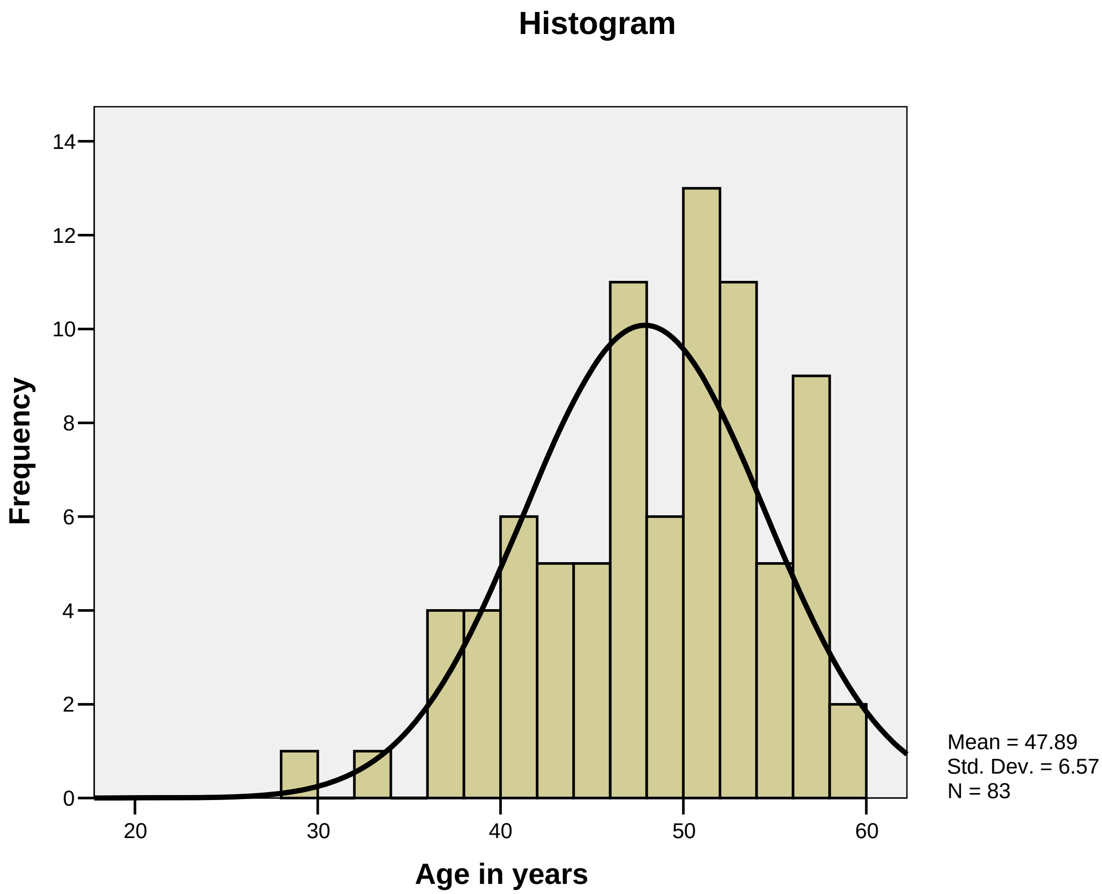

Figure 5.

Table C3

Education level for the Sample

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Some College	12	14.5	14.5	14.5
	Associate Degree	23	27.7	27.7	42.2
	Bachelor Degree	38	45.8	45.8	88.0
	Post Graduate	5	6.0	6.0	94.0
	Master's Degree	5	6.0	6.0	100.0
	Total	83	100.0	100.0	

Table C4

Years of experience in the HFD of the Sample

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	2	2.4	2.4	2.4
	6-10 years	1	1.2	1.2	3.6
	11-15 years	15	18.1	18.1	21.7
	16-20 years	29	34.9	34.9	56.6
	21-25 years	17	20.5	20.5	77.1
	more than 25 years	19	22.9	22.9	100.0
	Total	83	100.0	100.0	

Table C5

Remaining Years to retirement from the HFD for the sample

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	5	6.0	6.0	6.0
	1-5 years	29	34.9	34.9	41.0
	6-10 years	30	36.1	36.1	77.1
	11-15 years	15	18.1	18.1	95.2
	16-20 years	2	2.4	2.4	97.6
	more than 25 years	2	2.4	2.4	100.0
	Total	83	100.0	100.0	

Table C6

Responses by Rank

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Firefighter Recruit	2	2.4	2.4	2.4
	Firefighter 2	1	1.2	1.2	3.6
	Firefighter 3	13	15.7	15.7	19.3
	Captain	58	69.9	69.9	89.2
	Battalion Chief	9	10.8	10.8	100.0
	Total	83	100.0	100.0	

Table C7

Number of Months Using the MDT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 month	8	9.6	9.6	9.6
	1-3 months	42	50.6	50.6	60.2
	4-6 months	14	16.9	16.9	77.1
	7-9 months	9	10.8	10.8	88.0
	10-12 months	5	6.0	6.0	94.0
	More than 12 months	5	6.0	6.0	100.0
	Total	83	100.0	100.0	

Table C8
Improve MDT Training-more hands-on practice needed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Most Important	34	41.0	41.0	41.0
	Moderately Important	17	20.5	20.5	61.4
	Slightly Important	9	10.8	10.8	72.3
	Not Very Important	3	3.6	3.6	75.9
	Least Important	3	3.6	3.6	79.5
	No Improvements Needed	17	20.5	20.5	100.0
	Total	83	100.0	100.0	

Table C9
Improve MDT Training-training manual

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Most Important	15	18.1	18.1	18.1
	Moderately Important	16	19.3	19.3	37.3
	Slightly Important	12	14.5	14.5	51.8
	Less Important	2	2.4	2.4	54.2
	Not Very Important	8	9.6	9.6	63.9
	Least Important	4	4.8	4.8	68.7
	No Improvements Needed	26	31.3	31.3	100.0
	Total	83	100.0	100.0	

Table C10
Estimated percentage of time the MDT is working properly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	2	2.4	2.4	2.4
	1-25%	5	6.0	6.0	8.4
	26-50%	12	14.5	14.5	22.9
	51-75%	20	24.1	24.1	47.0
	76-100%	40	48.2	48.2	95.2
	Always	3	3.6	3.6	98.8
	Not Sure	1	1.2	1.2	100.0
	Total	83	100.0	100.0	

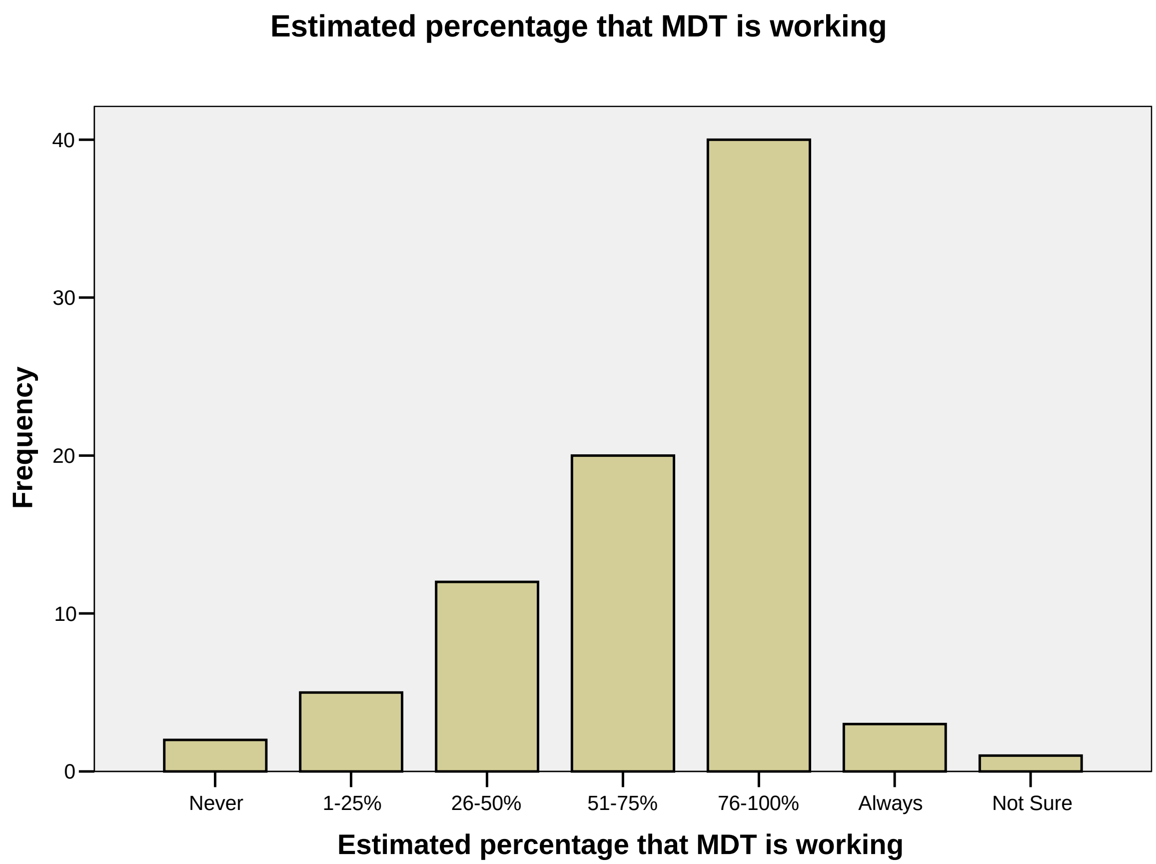

Figure 6.

Table C11
Rank MDT problems-Network Connection

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Most Significant	43	51.8	51.8	51.8
	Very Significant	11	13.3	13.3	65.1
	More Significant	5	6.0	6.0	71.1
	Moderately Significant	1	1.2	1.2	72.3
	Slightly Significant	2	2.4	2.4	74.7
	Neutral	2	2.4	2.4	77.1
	Not Very Significant	1	1.2	1.2	78.3
	Not Significant at All	1	1.2	1.2	79.5
	No Problems	17	20.5	20.5	100.0
	Total	83	100.0	100.0	

Table C12
Rank MDT problems-Apparatus Battery Drain

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Most Significant	20	24.1	24.1	24.1
	Very Significant	13	15.7	15.7	39.8
	More Significant	5	6.0	6.0	45.8
	Moderately Significant	3	3.6	3.6	49.4
	Neutral	1	1.2	1.2	50.6
	Not Very Significant	1	1.2	1.2	51.8
	Not Significant at All	6	7.2	7.2	59.0
	No Problems	34	41.0	41.0	100.0
	Total	83	100.0	100.0	

Table C13
Intent of the sample to use the MDT regularly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	18	21.7	21.7	21.7
	Agree	63	75.9	75.9	97.6
	Not Sure	1	1.2	1.2	98.8
	Disagree	1	1.2	1.2	100.0
	Total	83	100.0	100.0	

Table C14
Frequency of the sample who perceive *the MDT easy to understand*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	2	2.4	2.4	2.4
	Agree	65	78.3	78.3	80.7
	Not Sure	10	12.0	12.0	92.8
	Disagree	6	7.2	7.2	100.0
	Total	83	100.0	100.0	

Table C15
Frequency of the sample who perceive the MDT helps them do their job

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	15	18.1	18.1	18.1
	Agree	56	67.5	67.5	85.5
	Not Sure	8	9.6	9.6	95.2
	Disagree	4	4.8	4.8	100.0
	Total	83	100.0	100.0	

Table C16

Frequency of the sample who perceive the MDT improves efficiency at emergencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	11	13.3	13.4	13.4
	Agree	39	47.0	47.6	61.0
	Not Sure	26	31.3	31.7	92.7
	Disagree	6	7.2	7.3	100.0
	Total	82	98.8	100.0	
Missing	System	1	1.2		
Total		83	100.0		

Table C17

Frequency of the sample who know how to use the MDT properly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	6	7.2	7.2	7.2
	Agree	61	73.5	73.5	80.7
	Not Sure	13	15.7	15.7	96.4
	Disagree	3	3.6	3.6	100.0
	Total	83	100.0	100.0	

Table C18

Frequency of the sample who perceive the MDT easy to use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	4	4.8	4.8	4.8
	Agree	53	63.9	63.9	68.7
	Not Sure	16	19.3	19.3	88.0
	Disagree	9	10.8	10.8	98.8
	Strongly Disagree	1	1.2	1.2	100.0
	Total	83	100.0	100.0	

Table C19

Frequency of the sample who perceive using the MDT requires too much effort

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	2	2.4	2.4	2.4
	Agree	6	7.2	7.2	9.6
	Not Sure	17	20.5	20.5	30.1
	Disagree	47	56.6	56.6	86.7
	Strongly Disagree	11	13.3	13.3	100.0
	Total	83	100.0	100.0	

Table C20

Frequency of the sample who perceive the MDT improves safety at emergencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	11	13.3	13.3	13.3
	Agree	20	24.1	24.1	37.3
	Not Sure	40	48.2	48.2	85.5
	Disagree	11	13.3	13.3	98.8
	Strongly Disagree	1	1.2	1.2	100.0
	Total	83	100.0	100.0	

Table C21

Non-parametric correlation between the variables for adequate MDT training and know-how to use the MDT properly

			Did you receive adequate MDT training	Do you know how to use MDT properly
Kendall's tau_b	Did you receive adequate MDT training	Correlation Coefficient	1.000	.548**
		Sig. (2-tailed)	.	.000
		N	83	83
	Do you know how to use MDT properly	Correlation Coefficient	.548**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83
Spearman's rho	Did you receive adequate MDT training	Correlation Coefficient	1.000	.573**
		Sig. (2-tailed)	.	.000
		N	83	83
	Do you know how to use MDT properly	Correlation Coefficient	.573**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

Table C22

Non-parametric correlation between the variables for adequate MDT training and perceived ease of MDT use

			Did you receive adequate MDT training	Is the MDT easy to use
Kendall's tau_b	Did you receive adequate MDT training	Correlation Coefficient	1.000	.474**
		Sig. (2-tailed)	.	.000
		N	83	83
	Is the MDT easy to use	Correlation Coefficient	.474**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83
Spearman's rho	Did you receive adequate MDT training	Correlation Coefficient	1.000	.503**
		Sig. (2-tailed)	.	.000
		N	83	83
	Is the MDT easy to use	Correlation Coefficient	.503**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

Table C23

Non-parametric correlation between the variables for adequate MDT training and MDT ease of understanding

			Did you receive adequate MDT training	Is the MDT easy to understand
Kendall's tau_b	Did you receive adequate MDT training	Correlation Coefficient	1.000	.351**
		Sig. (2-tailed)	.	.001
		N	83	83
	Is the MDT easy to understand	Correlation Coefficient	.351**	1.000
		Sig. (2-tailed)	.001	.
		N	83	83
Spearman's rho	Did you receive adequate MDT training	Correlation Coefficient	1.000	.375**
		Sig. (2-tailed)	.	.000
		N	83	83
	Is the MDT easy to understand	Correlation Coefficient	.375**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

Table C24
Non-parametric correlation between the variables for perceived ease of MDT use and perception that the MDT helps personnel do their job

			Is the MDT easy to use	Does the MDT help you do your job
Kendall's tau_b	Is the MDT easy to use	Correlation Coefficient	1.000	.295**
		Sig. (2-tailed)	.	.003
		N	83	83
	Does the MDT help you do your job	Correlation Coefficient	.295**	1.000
		Sig. (2-tailed)	.003	.
		N	83	83
Spearman's rho	Is the MDT easy to use	Correlation Coefficient	1.000	.319**
		Sig. (2-tailed)	.	.003
		N	83	83
	Does the MDT help you do your job	Correlation Coefficient	.319**	1.000
		Sig. (2-tailed)	.003	.
		N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

Table C25
Non-parametric correlation between the variables for MDT ease of use and intent to use the MDT

			Is the MDT easy to use	Do you intend to use MDT regularly
Kendall's tau_b	Is the MDT easy to use	Correlation Coefficient	1.000	.384**
		Sig. (2-tailed)	.	.000
		N	83	83
	Do you intend to use MDT regularly	Correlation Coefficient	.384**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83
Spearman's rho	Is the MDT easy to use	Correlation Coefficient	1.000	.407**
		Sig. (2-tailed)	.	.000
		N	83	83
	Do you intend to use MDT regularly	Correlation Coefficient	.407**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

Table C26

Non-parametric correlation between the variables for adequate MDT training and perception that the MDT helps personnel do their job

			Did you receive adequate MDT training	Does the MDT help you do your job
Kendall's tau_b	Did you receive adequate MDT training	Correlation Coefficient	1.000	.404**
		Sig. (2-tailed)	.	.000
		N	83	83
	Does the MDT help you do your job	Correlation Coefficient	.404**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83
Spearman's rho	Did you receive adequate MDT training	Correlation Coefficient	1.000	.435**
		Sig. (2-tailed)	.	.000
		N	83	83
	Does the MDT help you do your job	Correlation Coefficient	.435**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

Table C27

Non-parametric correlation between the variables for knowledge to use MDT properly and perception that the MDT helps personnel do their job

			Do you know how to use MDT properly	Does the MDT help you do your job
Kendall's tau_b	Do you know how to use MDT properly	Correlation Coefficient	1.000	.487**
		Sig. (2-tailed)	.	.000
		N	83	83
	Does the MDT help you do your job	Correlation Coefficient	.487**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83
Spearman's rho	Do you know how to use MDT properly	Correlation Coefficient	1.000	.518**
		Sig. (2-tailed)	.	.000
		N	83	83
	Does the MDT help you do your job	Correlation Coefficient	.518**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

Table C28

Non-parametric correlation between the variables for perception that the MDT helps personnel do their job and their intent to use the MDT

			Does the MDT help you do your job	Do you intend to use MDT regularly
Kendall's tau_b	Does the MDT help you do your job	Correlation Coefficient	1.000	.388**
		Sig. (2-tailed)	.	.000
		N	83	83
	Do you intend to use MDT regularly	Correlation Coefficient	.388**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83
Spearman's rho	Does the MDT help you do your job	Correlation Coefficient	1.000	.412**
		Sig. (2-tailed)	.	.000
		N	83	83
	Do you intend to use MDT regularly	Correlation Coefficient	.412**	1.000
		Sig. (2-tailed)	.000	.
		N	83	83

**. Correlation is significant at the 0.01 level (2-tailed).

Table C29

Non-parametric correlation between the number of months using the MDT and the knowledge to use the MDT properly

			Number of Months Using MDT	Do you know how to use MDT properly
Kendall's tau_b	Number of Months Using MDT	Correlation Coefficient	1.000	-.244*
		Sig. (2-tailed)	.	.012
		N	83	83
	Do you know how to use MDT properly	Correlation Coefficient	-.244*	1.000
		Sig. (2-tailed)	.012	.
		N	83	83
Spearman's rho	Number of Months Using MDT	Correlation Coefficient	1.000	-.277*
		Sig. (2-tailed)	.	.011
		N	83	83
	Do you know how to use MDT properly	Correlation Coefficient	-.277*	1.000
		Sig. (2-tailed)	.011	.
		N	83	83

*. Correlation is significant at the 0.05 level (2-tailed).

Figure Captions

Figure 1. The technology acceptance model by Davis (1989).

Figure 2. The theory of reasoned action by Ajzen and Fishbein (1977).

Figure 3. The task-technology fit model by Dishaw, Strong, and Bandy (2002).

Figure 4. Cingular EDGE network coverage map for Oahu. Areas without shading (white) have no signal reception.

Figure 5. Histogram from SPSS for the ages of the sample.

Figure 6. Estimated percentage of time the MDT is working.